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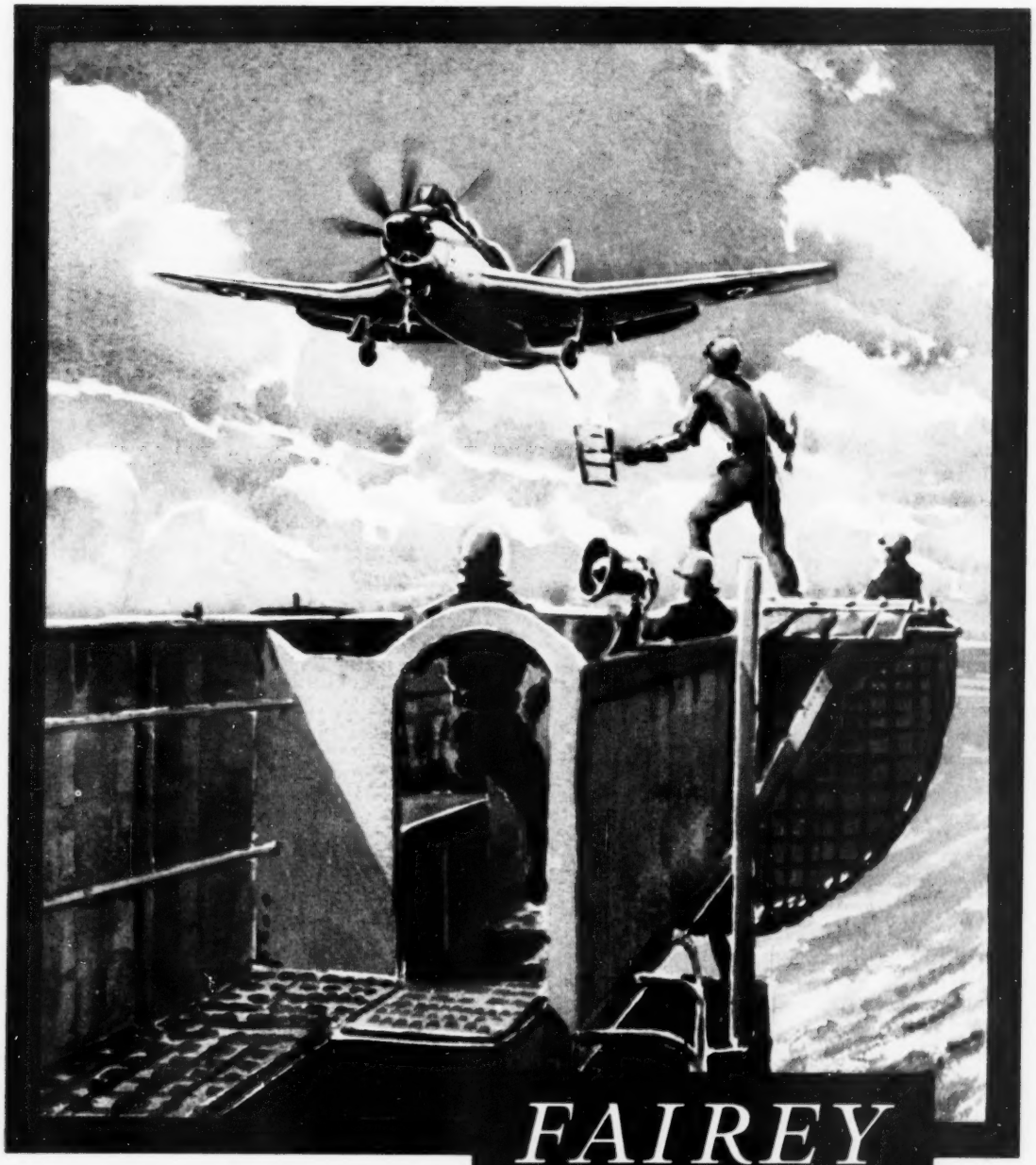

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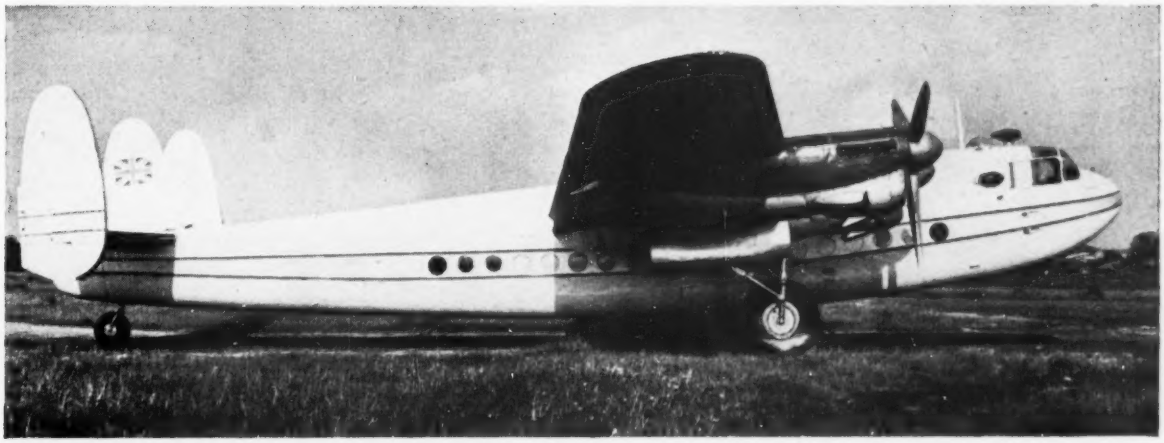

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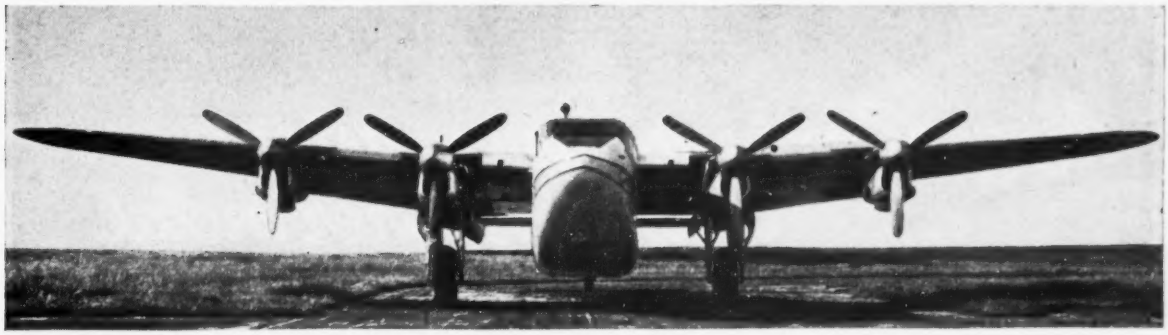

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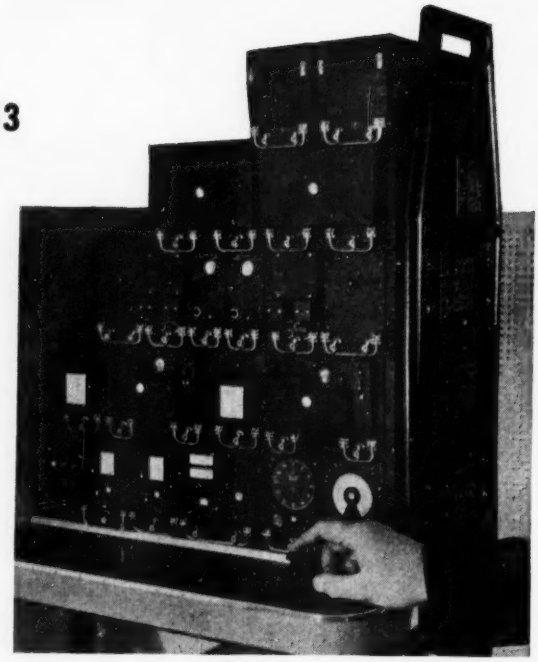

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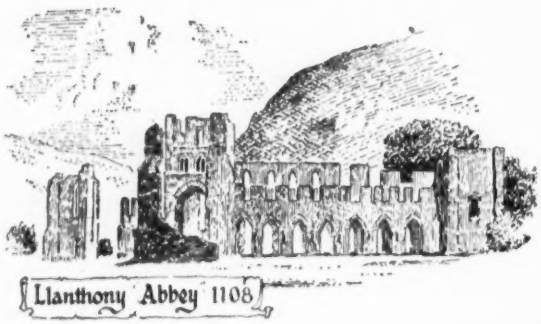

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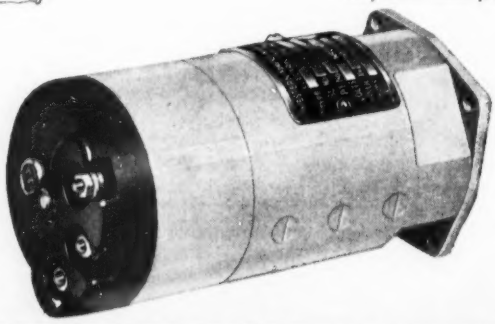

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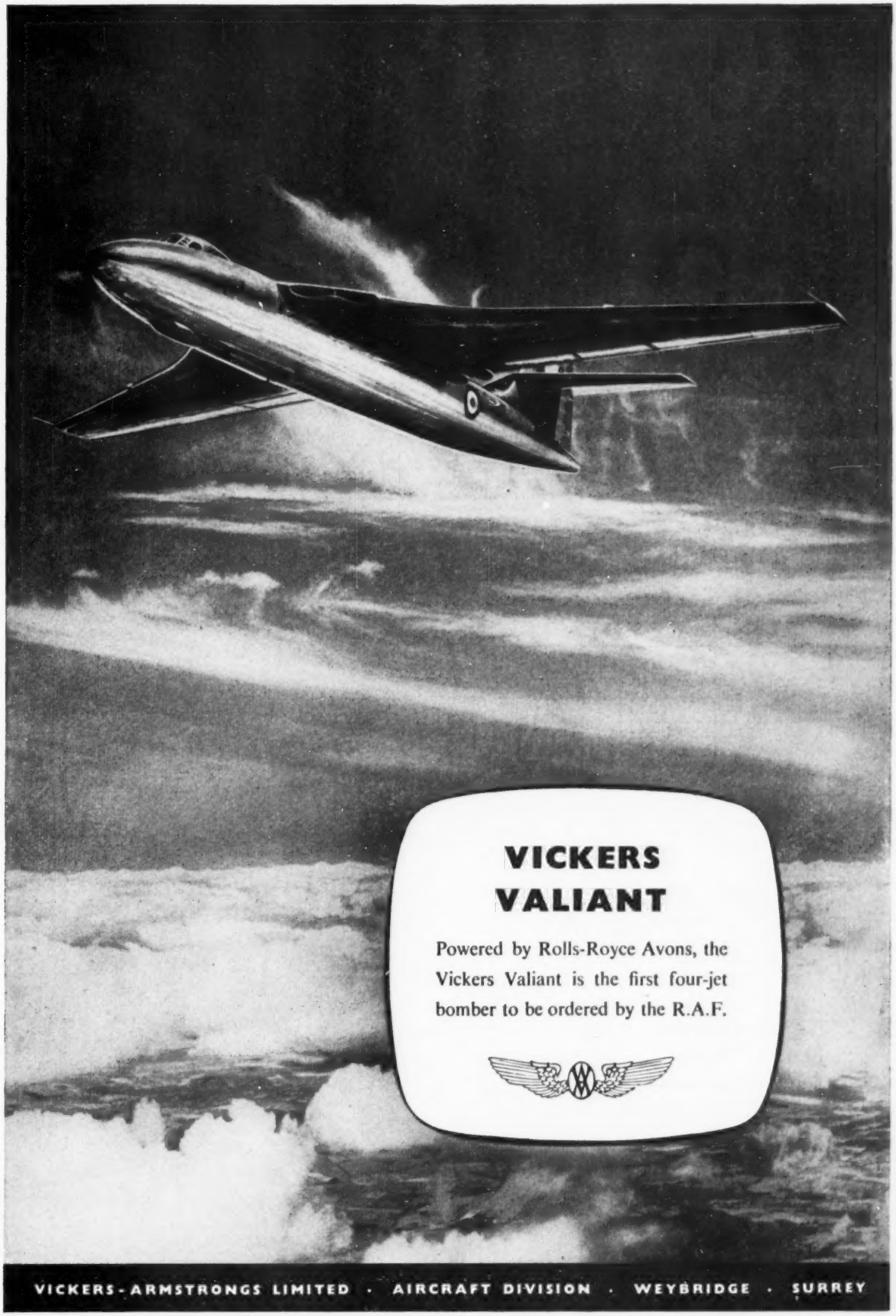
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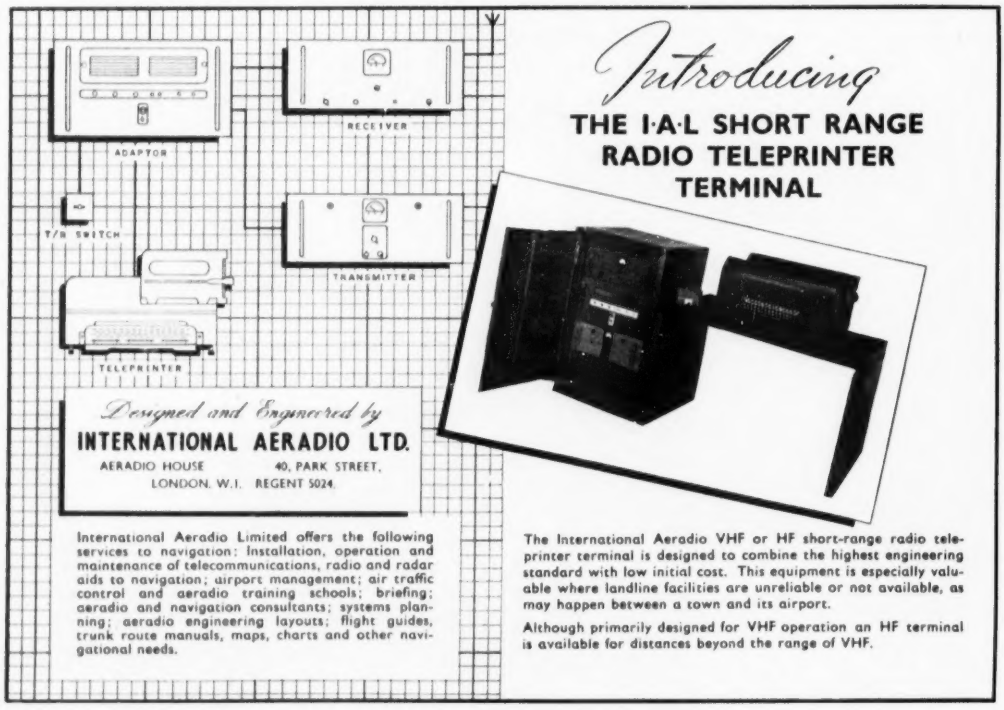

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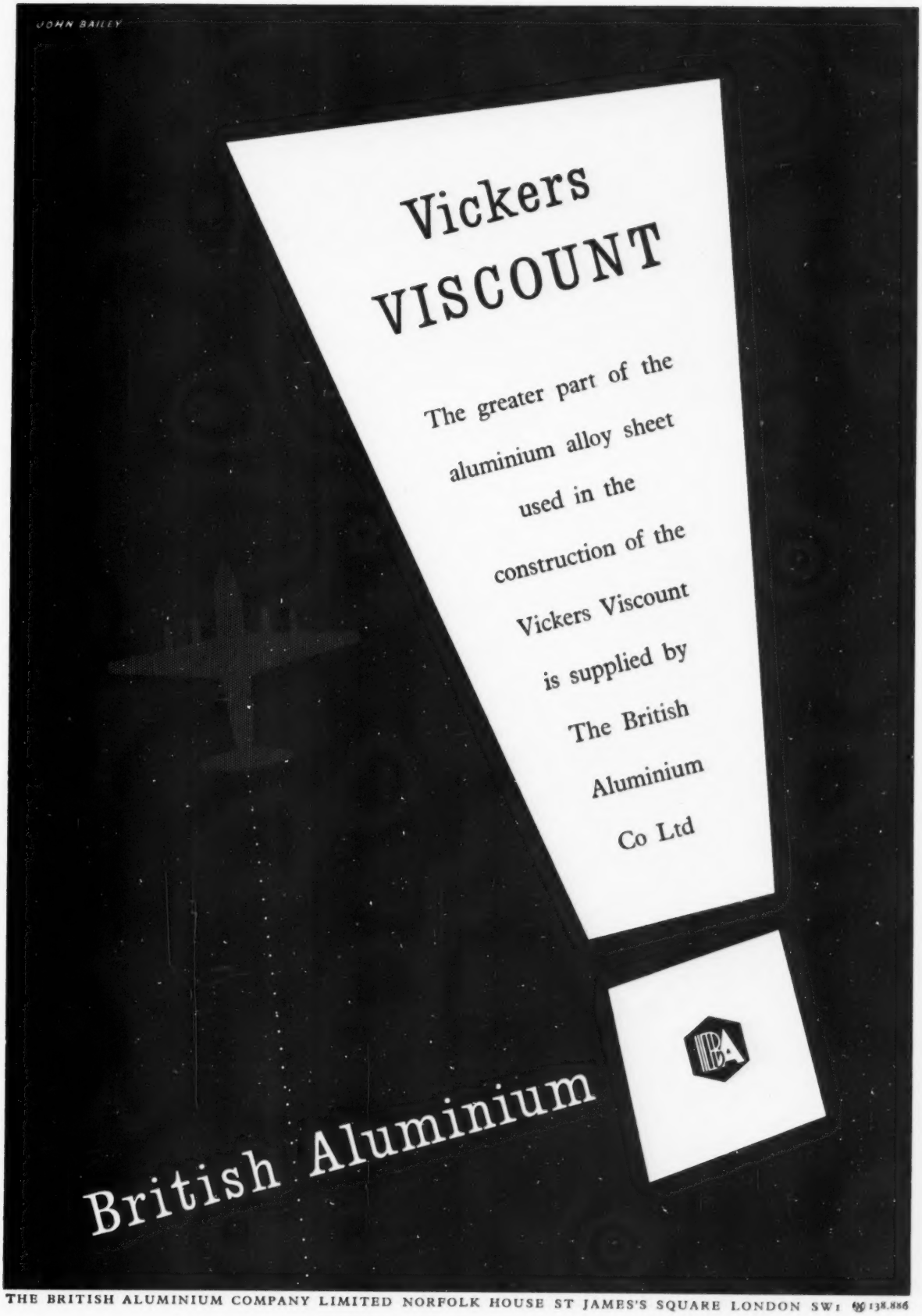
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Founded 1909

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EDITOR
MAURICE A. SMITH, D.F.C.

ASSISTANT EDITOR
H. F. KING, M.B.E.

ART EDITOR
JOHN YOXALL

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In Praise of Farnborough

AFTER the hurly-burly of Le Bourget, with its screaming, snarling, barrier-crashing jets, we offer this week an escape to the more tranquil skies of the past. We allude, of course, to J. M. Bruce's account of the S.E.5—a study which will doubtless evoke the same lively response as have its predecessors by the same author. For whatever weight of facts may be adduced concerning historic aircraft (and Mr. Bruce has an amazing faculty for amassing them) there is still ample ground for opinion and argument. Beyond challenge, however, is the S.E.'s reputation as one of the truly great fighting machines of all time; and if ever an aircraft justified the terms "war-winner" or "world-beater" it was this snub-nosed little single-seater biplane from Farnborough.

That the mere word Farnborough will act as a red rag to some of aviation's most redoubtable bulls we are well aware; yet the S.E. article leads us to sum up the credit side of Farnborough's account. The debit side has been rendered often enough—and not always with precision.

The Establishment can trace its ancestry back to 1878, when the War Office began experiments with balloons at Woolwich Arsenal. These led to the formation of the Balloon Section, Royal Engineers, which moved to Aldershot in 1892 and to Farnborough in 1905. From the Royal Aircraft Factory, as it was known between the years 1911 and 1918, there issued a stream of aircraft ranging from the poor to the inspired, including the B.E.2, R.E.8 and S.E.5 series, and some truly remarkable little rotary-engined scouts which were far ahead of their time. The B.S.1 of 1912, for instance, antedated by several months the Sopwith Tabloid, usually claimed as the first of the high-speed, single-seater scouts. Then there was the B.E.10 of 1915, with its full-span ailerons and flaps; the radio-controlled pilotless aircraft of the same year; various armoured biplanes; the F.E.12 night fighter, with searchlights and a rocket gun; the C.E.1 flying-boat; and various installations of variable-pitch airscrews—including, incidentally, one on an S.E.5, which would appear to have escaped even the lynx-eyed Mr. Bruce.

"Firsts" from the Factory

Engine development likewise took adventurous turns, and valuable work was put in on superchargers, including the turbo variety. That this never gained favour in this country was no fault of Farnborough's. Few people can be aware that the 14-cylinder R.A.F.8 radial was the forerunner of the famous Armstrong Siddeley line; nor is it widely known that the Factory issued the first C. of A. (for the B.E.1, dated March 14th, 1912) and laid down the basic principles for the stressing of aeroplane structures. With cold-blooded deliberation its pilots addressed themselves to the phenomenon of spinning and evolved the technique of inverted flight. The S.E.5 was a great favourite among them.

With the formation of the Royal Air Force in 1918 the Factory was redesignated as the Royal Aircraft Establishment. No further aircraft or engines were turned out, but the scope of research and development was broadened and an intimate liaison with the industry and the Services was fostered. To such history-making aircraft as the Hurricane, Spitfire, Wellington, Mosquito, Lancaster and Meteor, and to their power-plants and operational equipment, the R.A.E. made many significant contributions. The full extent of these is difficult to gauge, for the Boffin brotherhood has never courted publicity, and the excellent account of its work by John Pudney (*Laboratory of the Air*, H.M.S.O., 1948) was of a general nature only.

From time to time *Flight* has been enabled to publish articles dealing with specific aspects of Farnborough research, and year by year the Ministry of Supply exhibit at the S.B.A.C. Display is keenly awaited, for on that occasion the security veil is usually lifted from some R.A.E. development of uncommon interest. But whatever marvels may be cooking within the fences of the Establishment, be they electronic, ballistic, structural or aerodynamic, we doubt if any will surpass the achievements of the old S.E.

FROM ALL QUARTERS

More New Zealand Race Names

SOME further details of pilots and crews in the London-Christchurch (New Zealand) Race—starting at London Airport on October 8th—have been given by the Royal Aero Club.

In the Speed Section, the R.A.F.'s entry of a Valiant B. Mk 1 will have a mixed Service/civilian crew. It will be piloted by S/L. R. G. W. Oakley, D.S.O., D.F.C., D.F.M., with E. B. Trubshaw, M.V.O., as co-pilot (Mr. Trubshaw was recently appointed Vickers-Armstrongs' deputy chief test pilot); also on board will be F/L. W. R. Peasley, D.F.C. and Derek L. Jones (navigators), Frank Curtis (flight engineer) and Gordon R. Holland (flight observer).

The other R.A.F. entries—three P.R. Canberras—will be piloted by W/C. L. M. Hodges, D.S.O., D.F.C.; S/L. L. G. Press, A.F.C. (who, under A.V-M. D. A. Boyle, led the Canberra goodwill tour of South America last year); and F/L. R. L. E. Burton. The navigators will be S/L. R. Currie, A.F.C., F/L. J. W. Harper, D.F.C. and F/L. D. H. Gannon. Reserve pilot and navigator are F/L. R. M. Furze and F/L. T. E. Dunne.

In the Transport Handicap, B.E.A. will be represented by the prototype Viscount 700, G-AMAV, which has been loaned by the M.o.S. (it was originally stated that a 701 from scheduled service would be used). The captain will be chosen from among the following: J. W. G. James, A. S. Johnson, S. E. Jones, W. Baillie and—a noteworthy name—P. G. Masefield (though the Corporation's chief executive is usually seen as a pilot of light aircraft he has had considerable experience on heavier types).

A Merger of Ministries

THE amalgamation of the Ministries of Civil Aviation and Transport was formally endorsed by Parliament on July 8th, when a Humble Address was approved by the Commons.

A recent White Paper on the subject (*Flight* July 3rd) revealed little more than the effective date—October 1st. The Minister for Transport and Civil Aviation, Mr. A. T. Lennox-Boyd, went into considerably more detail, but his speech was concerned largely with reasons for the amalgamation, and several questions concerning the actual *modus operandi* remain unanswered. The Minister himself has successfully straddled the separate Ministries since he came into office last year; from his point of view the merger will serve to close the inconvenient gap between Berkeley Square and Theobald's Road. Whether or not successive Ministers will show equal ability in grasping the essentials of completely different forms of transport remains to be seen.

Again, the new status of senior M.C.A. officials *vis-à-vis* more senior M.o.T. executives is not clear. Thirdly, presumably the Corporations will, instead of receiving their share of the civil-aviation estimates, be allocated part of the overall budget for road, rail, sea and air. This could result in unrealistic comparisons between the results of the Corporations and the longer-established forms of transport.

Mr. Lennox-Boyd has proved himself to aviation as an air-minded Minister, but the new policy cannot be judged on his personal merits. Reactions to the forthcoming marriage between Transport and Civil Aviation, as expressed in the Commons, were tepid—there was little enthusiasm but, at the same time, few convincing objections were advanced. A summary of some views expressed in the debate follows.

MR. LENNOX-BOYD, in commending the merger, said that no suggestions could possibly be made that either of the two Departments—Transport or Civil Aviation—was in any sense running down. Economy in staff had been achieved by "very careful husbandry" and not by loss of work. Results by the M.C.A. had been "quite remarkable" in view of a passenger-mile increase from 363 million miles in 1946 to 1,229 million at present. All but 1,385 of the 7,000 people employed were to be found at outstations.

It was the Government's belief that, as civil aviation was essentially (and would become more and more) a matter of transport, it ought to be in a merged Ministry of all civil transport. The time had come to carry out the merger because things were settling down from the administrative point of view.

The Corporations had won the confidence of flying people all over the world and it was to be hoped that, with the Comets, Britannias, Viscounts, and Elizabethans, they would enter better financial times. The working of the new policy through the A.T.A.C. was going "remarkably well." In the Commonwealth, although much remained to be done, the general framework of civil air co-operation was now established. The pattern of bilateral arrangements had been reached and a large number made, and the ministerial need there was much less than it used to be.

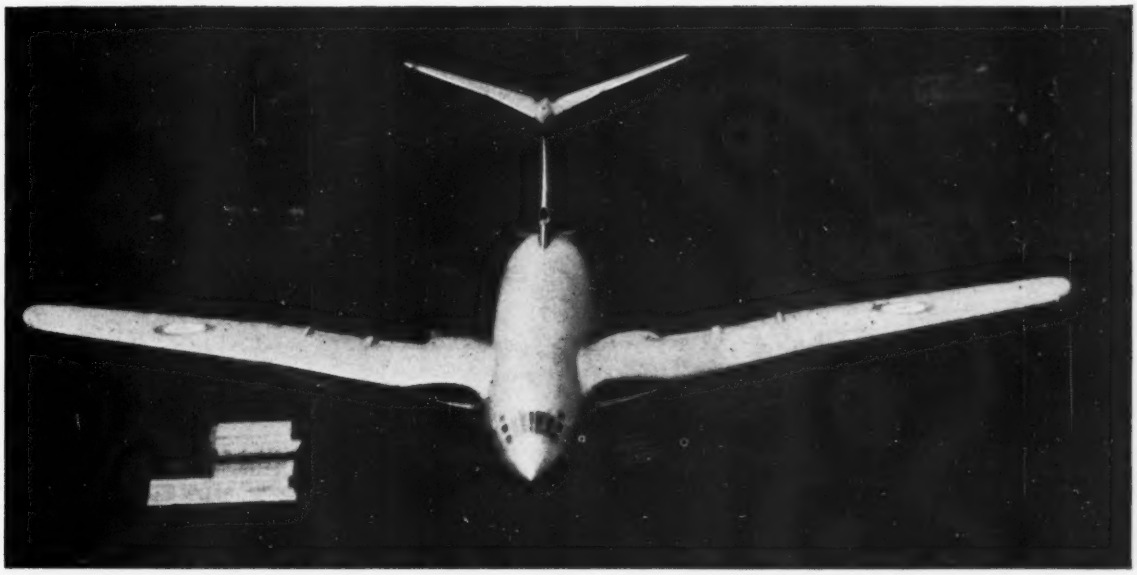
In airfield policy, the Department had pruned down to a smaller number the aerodromes previously thought necessary—all State-owned. In technical development, considerable advances had been made. Airline problems were, like those of rail and road safety, no longer unique. The airlines had fought their way through to a better recognition, and could be fairly dealt with in the merged Department. The nursing stage had passed, and now considerations of administrative efficiency must play their proper part. Road, rail, sea and air all made claims on the limited material resources at the same time. In this and many other fields a single Minister, devoted to getting the public the service it needed, was surely the best conclusion. There would certainly be some economies, although he would not put them very high. They would be in accounts and establishment and, to some extent, in finance.

Speaking personally, said Mr. Lennox-Boyd, sudden immersion in the Transport Act and the new policy on civil aviation had given him a good deal of strain and some considerable anxiety. The task had been made much more difficult by the fact that his two Departments had been in two separate buildings a long way apart; it would be enormously simplified by the merging of them in the physical sense

The Minister went on to remark that he and his successors would have the assistance, under the new set-up, of the Controller of Ground Services with senior officers in both Departments engaged in a multitude of responsibilities for transport by rail, road, sea, and air. Each of these Departments, through their officers, would bring to the other great advantages. The impact of the jet age, the turboprop and the turbojet on older forms of transport would do no harm to the Ministry of Transport. Conversely, the direct experience of many problems—finance, a great headache in civil aviation; the patient and often unspectacular planning and achievements in road and rail; the continual and often unsung running of the railways day after day—would do no harm either to those in the M.C.A.

MR. FRANK BESWICK (Lab., Uxbridge) commented that the Minister had not mentioned safety regulations in his list of departmental duties. There was a whole field of safety regulations and in no other case did circumstances change as they did in this field of activity. He could not think that Mr. Lennox-Boyd had had too much time to consider these methods in the last year. He also wondered if it could be said that the two Corporations were now safely "out of the red," that their respective responsibilities were clearly defined, and that their ability to meet foreign competition was such that they no longer needed a separate Minister to serve them. Mr. Beswick asked for the assurance that there was no intention to lower the status of civil aviation, and that, with the technical needs of civil aviation diverging sharply from the military needs, the voice of the Minister would be heard in the Cabinet or in Government circles in favour of the proper priorities for civil air transport.

MR. J. S. MACLAY (Nat. Lib. and Con., Renfrewshire, West), a former



V-SIGN: New views of the Handley Page Victor B.1, one of Britain's three "V"-bombers ordered for Bomber Command re-equipment. Since its maiden flight last Christmas Eve the Victor has been undergoing contractors' trials and on one day recently was airborne six times.

Minister of Transport and Civil Aviation, contended that the Minister had made a complete case for the timing. There were problems to be solved about the railways, about road transport, and about sea transport, as there were bound to be in relation to all forms of transport. If ever there was a need to get policy into one Department and under one Minister it was in this case. Transport could not be static. There was no case for saying that everything was settled either in civil aviation, the railways, sea transport, or road transport. Civil aviation, internationally as well as nationally, had been dry nursed, but sea transport had not. Civil aviation was a new industry coming up, but some time, fairly soon, someone would have to decide whether sea transport was to be subjected steadily to air competition. Sea transport paid all its own expenses, but civil aviation was still in a very privileged position. This was not necessarily wrong, because civil aviation was relatively an infant industry, but it was infinitely better for one Minister to be responsible for balancing these matters than to have two fighting a sort of battle.

G/C. C. A. B. WILCOCK (Lab., Derby, North) described the merger as the de-grading, or down-grading, of the M.C.A. It was clear that the Government regarded civil aviation as just another means of transport and not as a fundamental development in the progress of civilization.

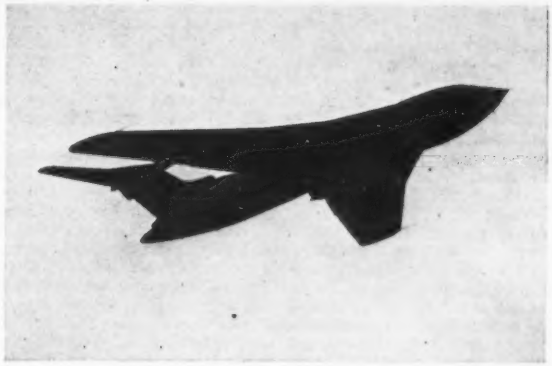
A. CDRE A. V. HARVEY (Con., Macclesfield) approved of the merger. He suggested that the Minister should delegate more of the administration of civil aviation to the Air Registration Board.

MR. IAN MIKARDO (Lab., Reading, South) maintained that there were still foundations to be laid in civil aviation, and that 1954 would have been a better year for the amalgamation.

MR. GEOFFREY DE FREITAS (Lab., Lincoln) expressed the view that the move reduced the status of civil aviation to the level of a branch line of British Railways.

MR. ERNEST DAVIES (Lab., Enfield, East) said that while the Opposition were not in principle opposed to the merger, it might have been better to have waited until the Corporations were no longer in need of subsidies, because so long as nationalized industries were receiving subsidies, then there was every justification for greater interference and a larger measure of control being exercised by the Minister responsible.

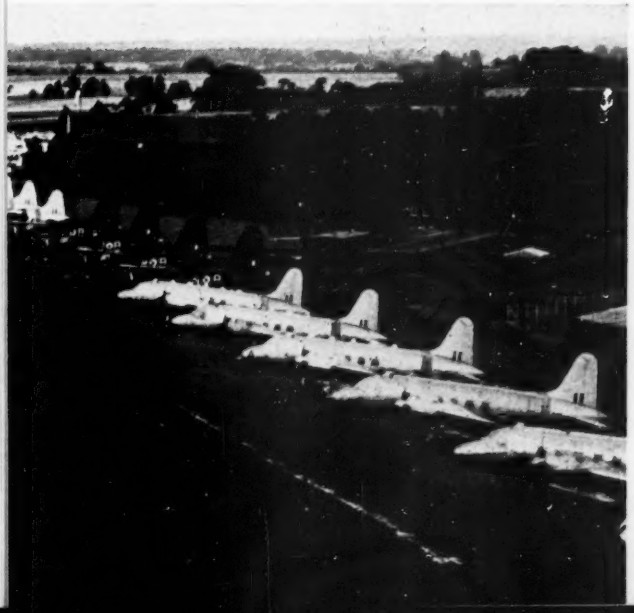
MR. J. D. PROFUMO, Parliamentary Secretary to the Ministry of Civil Aviation, replying to the debate, said there was no fundamental intention to cut down large numbers of staff. The Government were trying to carry out an operation which would in the end mean a more efficient administration. There was no ground whatsoever for thinking that the development of civil aviation would suffer, as the departmental organization would remain largely as at present.



Major Draper—£10 Costs

THE pilot who flew an Auster Autocrat under 15 Thames bridges (see *Flight*, May 15th), Maj. Christopher Draper, D.F.C., 61, was discharged conditionally when he appeared at Bow Street on June 11th, but was ordered to pay £10 costs. He was dealt with on one summons only—to which he pleaded guilty—that of flying an aircraft under Waterloo Bridge so as to cause unnecessary danger to persons and property.

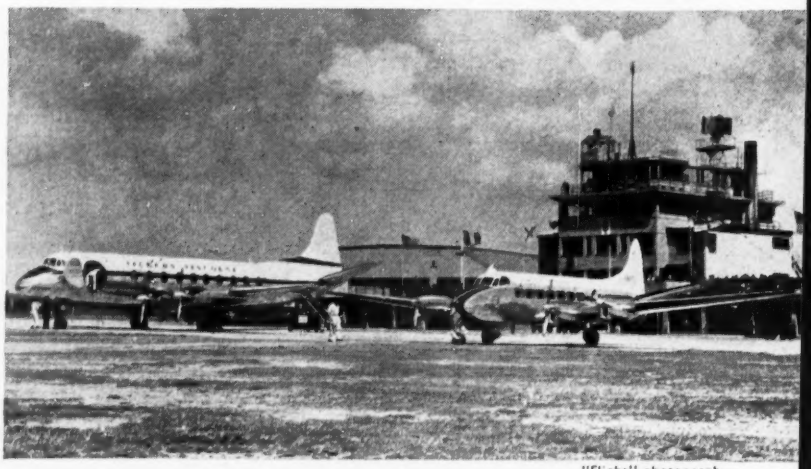
Announcing his decision, the Magistrate, Mr. Frank Milton, said he had taken into account Maj. Draper's character and antecedents. The offence was a piece of folly which should never have been undertaken. He had been greatly impressed by Maj. Draper's gallant and splendid past and his difficult struggle against adversity in recent periods; but it should be known that similar offences would be severely dealt with.



SHAPES AND SIZES: The scene at Odiham last week, with the aircraft, and some of the personnel, to be inspected by Her Majesty the Queen in Wednesday's historic review, in close and orderly array. Sabres, Hastings, Lancasters, Lincolns, Varsities, Neptunes and Valettas can be made out in the foreground. A detailed and fully illustrated description will appear in our next issue.

JERSEY'S CORONATION DISPLAY

A Visit to the busy C.I. Airport, and Home by Heron



"Flight" photograph

Visitor and resident: On the apron at Jersey are seen the Viscount 700 prototype and the locally based Heron of Jersey Airlines.

THE modest proportions of St. Peter's Airport, Jersey, belie the fact that it is one of the busiest air-traffic centres in the United Kingdom. Last year it handled 246,000 passengers and over 23,500 aircraft-movements—seven times as many passengers and four times as many aircraft as in 1938. All records are being broken this year; on July 4th, for example, 286 landings and take-offs were made on the 4,200ft single tarmac runway, and 4,090 passengers passed through the terminal building.

The airport is administered, independently of the M.C.A., by the State of Jersey Harbours and Airports Committee, under the presidency of the Constable of St. Ouen, Mr. F. Le Boutillier. Expressive of the airminded outlook of Jersey was the Committee's decision that an air display at St. Peter's should form a major contribution to Coronation festivities on the island. Thanks to efficient staffwork under Mr. R. T. A. Dalton, senior air-traffic control officer, a flow of scheduled passenger services was maintained while some 30,000 residents and holiday-makers watched the display—held in perfect weather on July 9th.

On arrival in Jersey the previous day, we had learned from Senator W. H. Krichefski, vice-president of the Harbours and Airports Committee, of some problems involved in organizing a display so far from the centres of the aircraft industry and Service flying. His particular regret was that the islanders would not see any of the latest high-speed British turbine-powered aircraft, due to the S.B.A.C. ruling against prototype demonstrations except in certain special circumstances. Fortunately, the Ministry of Supply authorized a brief first appearance by the Viscount 700 prototype, which arrived from Wisley shortly before the display, carrying the Minister of Transport and Civil Aviation, Mr. A. T. Lennox-Boyd, and Sir George Cribbett, Deputy Secretary.

An unusual start to the flying programme was provided by the arrival of the Lieutenant Governor, Sir Edward Grasett, in a Sikorsky S-55 of No. 705 Squadron. This, incidentally, was the very machine used by H.R.H. the Duke of Edinburgh for a number of official journeys earlier this year, and it was flown by the same pilot, Lt. Cdr. R. Spedding. There followed a fly-past of airliners: a Cambrian Air Services Dove, Jersey Airlines' glittering new Heron, a B.E.A. Elizabethan and the Viscount 700, flown by Capt. "Dickie" Rymer, who passed by with two Darts feathered before setting course for Wisley. Commentator Charles Gardner broadcast the news, just released, that this Viscount (G-AMAV) would be substituted for the B.E.A. Viscount 701 G-AMNZ as an entry in the New Zealand Race next October. Now well established in regular service, Viscounts are making a great deal of money for B.E.A., who are doubtless quite happy about this change of plans.

From Florennes, Belgium, flew 12 Thunderjets, which broke from their tidy formation for individual simulated strafing of the airport. This event was carried through at low level with the dash for which Belgian Air Force pilots are justly famous. F/L. L. A. Titmuss, leader of the C.F.S. aerobatic team, impressed public and pilots with his polished handling of the Meteor 7, and four fellow-instructors (S/L. Harkness, F/L. James, F/O. Evans and M. Plt. Fisher) gave a fine exhibition of air-drill in similar machines. Despite some turbulence at low levels, the Patrouille d'Etampes performed superbly in their Stampe S.V.4 biplanes, and on landing were loudly applauded by the crowd. As in previous displays, an individualist demonstrated rolls, loops, bunts, stall turns and inverted flying, and each manœuvre was reproduced in triplicate by the formation. The team, who participate in displays throughout the summer and train reserve pilots during the winter season, consists of Capt. Kerguelen, Lt. Darbois, Adj. Claveau and Adj. Menard. Thus established, French prestige was upheld by Lt. Tourangin, who appeared suddenly in a tip-tanked Dassault Ouragan from Bretigny. After a brief but impressive performance at high speed, he signed-off with a well-placed slow run past the crowd, using wheels, flaps and dive-brakes to stay in view as long as possible.

Three types of helicopter performed: S-55 and S-51 of 705 Squadron, and a U.S. Army Bell-47 from La Rochelle, piloted by Lt. J. T. Lendrum. Lt. Cdr. Spedding's spirited demonstration of the S-55 included one low-level manœuvre which, had he been flying a fixed-wing aircraft, might have been termed a stall turn, but defies further description.

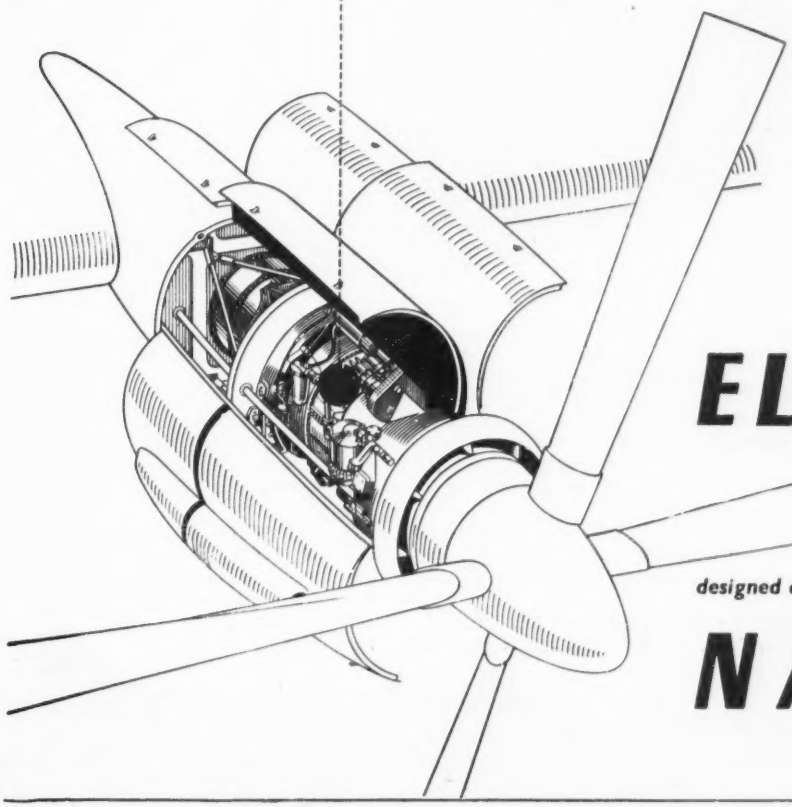
Led by Lt. Cdr. J. W. Powell, eight Firefly 6s of No. 826 Sqn., Lee-on-Solent, made a dive-bombing attack on a grey conning-tower which had "surfaced" near the runway. Their target was quickly lost in a shower of practice bombs and clouds of smoke, to the accompaniment of some suspiciously loud bangs. Belief that the submarine had been undermined was confirmed during the next and final event, when a Canberra apparently produced a sonic bang during a slow fly-past. Four Canberras were seen at Jersey—a formation of three and an individualist, all from No. 109 Sqn., Hemswell, and led by S/L. J. E. S. Hill. They put up an impressive show of speed and graceful manœuvrability, concluding with a stirring, noisy "beat-up": the ideal finale to Jersey's

(Left) The Ouragan from Bretigny begins a slow run past the enclosure; the Firefly 6 (right) of No. 826 Sqn. is making a dummy deck landing.

"Flight" photographs

Access to economy

The economics of maintenance are highly susceptible to variations in accessibility. In the design of the Eland maintenance facilities have been carefully studied, and the extreme compactness of this high-rated unit has been achieved in a manner which aids access to all points subject to periodical attention.



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The Saab-29 takes off with a heavy armament and fuel load for a long-range attack sortie.

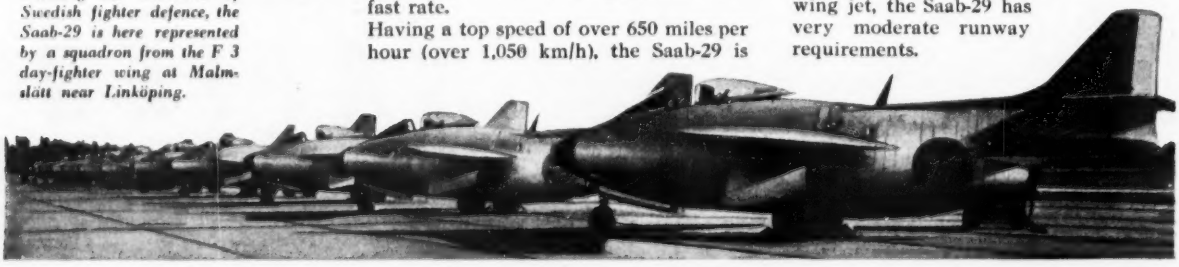
Forming the backbone of Swedish fighter defence, the Saab-29 is here represented by a squadron from the F 3 day-fighter wing at Malmslätt near Linköping.

Quick delivery is something quite unique when talking of *modern* jet fighters. Too often such aircraft are years away from operational service. The Swedish swept-wing Saab-29, however, represents a really outstanding exception from that „rule", by showing what can be achieved if imaginative engineering is coupled with sufficient production capacity.

The Saab-29 has been delivered in large quantities to the Royal Swedish Air Force, and many more are being produced at a fast rate.

Having a top speed of over 650 miles per hour (over 1,050 km/h), the Saab-29 is equipped with a powerful jet engine of internationally proven type. The aircraft itself has a very rugged design and a modern standard four-cannon armament of great firepower and exceptional accessibility.

The Saab-29 can be used for a variety military duties including interception, attack, and reconnaissance. For a swept-wing jet, the Saab-29 has very moderate runway requirements.



SVENSKA AEROPLAN AKTIEBOLAGET (SAAB AIRCRAFT COMPANY) · LINKÖPING · SWEDEN

Three pilots of the famed Patrouille d'Etampes: (left to right) Adj. Claveau, Lt. Darbois, Adj. Menard; their leader, not seen here, is Capt. Kerguelen.

Jersey personalities: Senator W. H. Krichefski, organiser of the display, with Mr. C. P. V. Roche (left), airport commandant, and Mr. J. H. Herbert, airport manager.

Flight photographs

JERSEY'S CORONATION DISPLAY . . .

Coronation display. If the public didn't receive value for money, that could only have been because admission was free.

Having admired the silver, white and blue Heron which took part in the display, we welcomed the opportunity of returning to the mainland in it the following morning. Jersey Airlines added the Heron, G-AMYU, to their fleet of six Rapides in May, and it has already flown over 300 hr on the Paris, Exeter and Gatwick routes. The company, incidentally, was formed some four years ago by the present chairman, Mr. M. L. Thomas. With virtually no previous experience of running an airline, he has nevertheless built up an enviable reputation for efficiency and reliability. Mr. D. Le Calvez, the traffic manager and self-termed "general factotum," told us that the company's Jersey staff now totals 50, with representatives in London, Exeter, Bournemouth, Coventry, Gatwick, Paris, Dinard and St. Brieuc.

The Heron, though expensive to buy, is cheap to operate and has proved equally popular with its pilots and with the travelling public. The loss of one engine affects performance very little, and it can be flown safely on two. Within 15 min the Heron's interior can be converted to any of three versions: 14, 15 or 17 seats, according to the route. Load factors to date suggest that these capacities are just about right for the present Jersey Airlines network.

The cabin is neatly finished in grey and fawn, with eight windows (seven large, one small) on each side, giving good view and a light and airy effect within. From Jersey the Heron flew (in 15-seat form) with only two seats vacant—and these were reserved for passengers from Alderney, 18 minutes away. Capt. Bradley set "Yoke Uncle" down in less than half the 2,730ft grass runway available on this little island. We taxied to the miniature terminal building and exchanged one passenger for three. On these short routes the Heron can comfortably be operated by a one-man crew, so that Capt. Bradley was able to invite *Flight* up-front for the one-hour Alderney-Gatwick stage. Perhaps the most significant part of the trip was the take-off: at little below all-up weight the Heron soared willingly with plenty of run in hand, bearing out the pilot's observation that "she leaps into the air." At 4,500ft, with the Gipsy Queen 30s set to give 1,900 r.p.m. and 24in. of boost, the Heron cruised at 160 m.p.h. We touched down at Gatwick, 150 miles away, exactly an hour later. The M.C.A. party, headed by Mr. Lennox-Boyd, returned to Gatwick from Alderney in Jersey's Heron later the same day. R.B.

REARSBY'S MIXED BAG

THE appearance of a Boeing B-47 Stratojet and the Dart Kitten on the same programme gave some indication of the wide variety of fare offered at this year's Air Display of the Auster Flying Club at Rearsby. The July 11th forecast of bad weather proved to be premature, and the afternoon was bright as the trumpet band of No. 1 City of Leicester Squadron—the founder-squadron of the Air Training Corps—provided a musical preface to the flying programme.

A fly-past of a varied selection of visiting aircraft took place first. Among these types were the Hirtenberg H.S.9A, Fred Dunkerley's Gemini, Ron Paine's Hawk Speed Six, Aviation Traders' Ercoupe, Dunlop Aviation's Dove, and an ultra-light circus consisting of a Dart Kitten, Fairey Junior, B.A.C. Drone and Tipsy trainer. Geoffrey Alington in the neat Fairey Junior gave a demonstration of aerobatics; then smilingly passed before the crowd and dropped in gently to land. Views of the home product were then given: an Aiglet of Aerial Spraying Contractors sprayed the airfield—and some of the crowd—and Ranald Porteus gave another of his admirable demonstrations, of both polished aerobatics and crazy flying, in the Aiglet Trainer G-AMMS.

From the Naval Air Fighting Development Unit at West Raynham came an Attacker, shown to good advantage in both low- and high-speed runs by Commissioned Pilot Darlington. The Auster Ambulance/Freighter appeared twice during the afternoon, showing its abilities in both rôles, firstly by carrying two stretcher patients, and later by carrying—and dropping undamaged—a load of crockery. The Gloster Gladiator G-AMRK was then demonstrated by V. H. Bellamy, an ex-Naval pilot who flew the type during the war and who owns this particular machine.

After a road-safety demonstration by members of the Leicestershire and Rutland Constabulary, an exhibition of sailplane aerobatics was given by George Thompson in the green Olympia loaned by Mr. Jack Rice. Two high-speed low-altitude runs past the crowd preceded a final well-judged landing. A demonstration of the use of A.O.P. Austers then followed, by members of No. 664 (A.O.P.) Squadron, R.Aux.A.F., 25-pr. guns manned by Territorial personnel being directed on to a target on a nearby hillside.

Hesitation rolls were a striking feature of the next display, by F/O. Camp in a Meteor 4 of the R.A.F. Central Flying School. This preceded the highlight of the afternoon, the appearance of a Boeing B-47. After some difficulty in finding the airfield, the huge machine was brought in to make a 400-kt run across the field at about 1,000ft, and to provide the spectators with a new shape in the sky over Leicestershire.

Next came the incomparable Patrouille d'Etampes, giving their first exhibition at Rearsby. Especially appreciated in their magnificent display were the formation vertical reverses and the solo low-altitude inverted runs. Meteor 8s of 610 and 611 Squadrons of the R.Aux.A.F followed in a selection of formation manœuvres. A varied programme was concluded by F/L. Hutchins, who performed Chipmunk aerobatics at the direct R/T request of some of the younger generation, and by "Chuck" Thompson, who—returning from his honeymoon and arriving late—performed a spectacular delayed parachute drop.

A WEEK TOMORROW

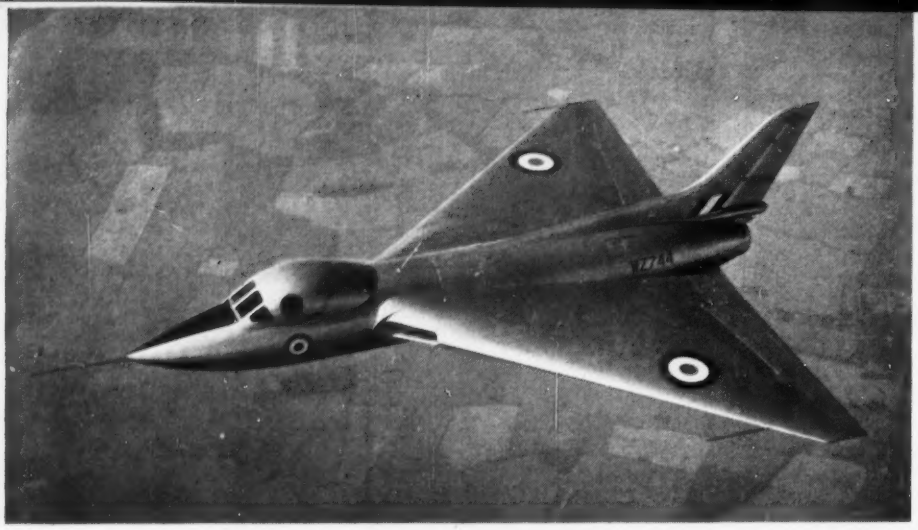
AS already announced in these pages, it is hoped that several prototype aircraft flown by their makers' test pilots will participate in the Royal Naval Air Day at Stretton, near Warrington, on Saturday, July 25th. A very full flying programme has been arranged, beginning at 2.30 p.m. (gates open, 10.30 a.m.). Admission prices (in aid of Naval charities) are 3s (children 1s), with car parking 2s 6d; these are considerably reduced if advance bookings are made, through local branches of W. H. Smith and Son, or travel agencies.

On the same day a Naval Air "At Home" is being held in the South—at Ford, near Littlehampton. Gates open at 1.30 p.m. and flying begins at 2.30. Admission is 1s (children 6d); cars are 5s (including up to three occupants) or 7s 6d (four or more occupants). Formation aerobatics by Attackers will be a feature of the programme, and there will also be demonstrations of S-51, S-55 and Hiller helicopters.

Beginning on July 25th is the 1953 National Gliding Championship meeting at Great Hucklow, Derbyshire, which continues until August 3rd.

Also on the 25th is the National Air Touring Competition organized by the Royal Aero Club. This, as already announced, is to start and end at Panshanger Airfield.

Three days earlier, on Wednesday next, July 22, "At Homes" are scheduled to take place at the Royal Naval Air Stations at St. Merryn and Arbroath.



DUAL DELTA: First photograph of the Avro 707C trainer, which has dual control and side-by-side seating. Five Avro deltas are now flying—the Vulcan bomber, the low-speed 707B, two 707As, and the 707C. Pilot of the 707C on its maiden flight was S/L. T. B. Wales, O.B.E., D.F.C., T.D. He took off from Waddington, near Avro's Bracebridge Heath factory at Lincoln, on July 1st, and flew to the company's airfield at Woodford.

HERE AND THERE

Against the Terrorists

IN ten weeks up to July 9th, Harvards operating against the Mau Mau in Kenya, flew 183 sorties against 85 targets, dropping 1,096 bombs and firing 96,000 rounds of ammunition. Interrogation of prisoners, it was stated, suggested that the measures had proved effective, particularly on the morale of gangs in the prohibited areas.

No Round Figures

TOKYO radio reports that Japan will turn out 234 aircraft fuselages, 306 engines, and spare parts to the value of 74 million yen during the fiscal year 1953. These figures suggest very big increases as compared with 1952, when only 11 fuselages, seven engines, and spares to the value of only about 3¼ million yen were produced.

Silence in Court?

AFTER the noise of low-flying jet aircraft had interrupted proceedings at Kent Assizes on Wednesday of last week, Mr. Justice Croome-Johnson sent for the C.O. of the nearby R.A.F. station at West Malling. The officer, G/C. Peter Walker, told the judge that none of the aircraft flying over Maidstone on that day came from his station; some of them, he said, might have been practising for the R.A.F. Review. (His lordship made a similar protest in 1949, and on that occasion his sending for the C.O. gave rise to Parliamentary questions.)

Two More Quick Trips

ON his return journey from Paris in the Canberra which he had been demonstrating at the Show, W/C. Roland Beamont flew from Le Bourget to the English Electric airfield at Warton, Lancs, in 42¼ min for the 408 miles—a speed of 576 m.p.h. He was not assisted by a following wind, and the journey included a climb to, and descent from, an operational altitude of 40,000ft. A few days previously, another English Electric test pilot, John Squier, had flown from Warton to Le Bourget in just one minute longer than Beamont's time.

New R.Ae.C. House Secretary

THE Royal Aero Club announces that Maj. Norman Dicks, M.C., will succeed Mr. O'Connor as house secretary on August 31st. A Fellow of the Hotel and Catering Institute, Maj. Dicks was attached to the U.S.A.A.F. during the war; from 1945-52 he was secretary to Boodle's, St. James's Street.

Same Again

A RATHER appealing news-story appeared in *The Times* last week. It appears that a Puerto Rican gentleman, speaking only Spanish, set off to return from New York to his native land by air. Some curious mistake led to his boarding an aircraft bound for Frankfurt. After take-off, and being invited by the stewardess to have a drink, he gave his name, which happened to be Martinez. A dry martini was promptly served and, says the story, "As the aircraft winged northward instead of southward, this performance was apparently repeated several times before the first port of call, Gander, Newfoundland, was reached. There the error was noticed by Mr. Martinez, who, in spite of the abundance of refreshment, detected what appeared to be unusually cool weather for a Caribbean July."

No Supersonic Secrets

A TIGER MOTH flown by two Danes made a forced landing in the Russian Zone near Lubeck last week. It was promptly returned—carried along the roads by 20 East German police—together with its crew.

Protective Slots

A NEW type of pilot's helmet, designed with the conditions of baling-out at high speeds in mind, has been produced by the Douglas Aircraft Company for the U.S.A.F Research and Development Command. The new helmet has slots in the forward crown to reduce the air interference and the possibility of the helmet being blown off when the pilot is ejected at high speed. It has been tunnel-tested to Mach 1.04.

One Postponement—

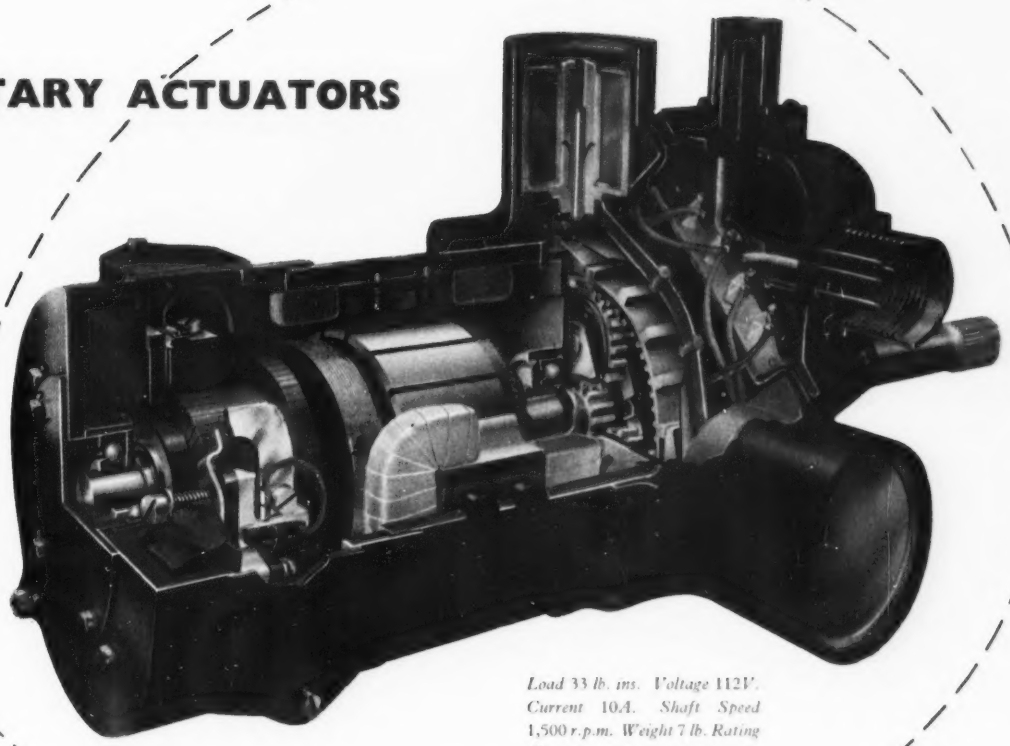
THE St. Albans Model Aero Club's All-Britain Rally, to have been held at Radlett Airfield on August 23rd, has been postponed until Sunday, September 20th, for the reason that Handley Page, Ltd., are likely to require the use of their airfield on the earlier date. Other model-flying news is that the S.M.A.E.'s big international meeting at Cranfield from August 1st to 3rd has already attracted entries from more than 20 foreign countries.

—and Another

THE Vintage Aeroplane Club's rally which was to have been held at White Waltham tomorrow, July 18th, has been postponed until August 29th in an effort to obtain further support. The date for entries for the various races has been extended until August 15th, but the programme will remain unchanged. A meeting is to be held at Denham at 7.30 p.m. today, July 17th, in an endeavour to encourage more pilots to take part.

THE STAR OF DAVID, national insignia of the Israeli Air Force, is borne by the Force's newly acquired Gloster Meteor 7s and 8s, three of which are seen in this photograph, secured during a recent Press showing in Israel. The machines are flown by R.A.F.-trained Israeli pilots. Sizeable quantities of Mosquitoes and Mustangs are also in service.

ROTARY ACTUATORS



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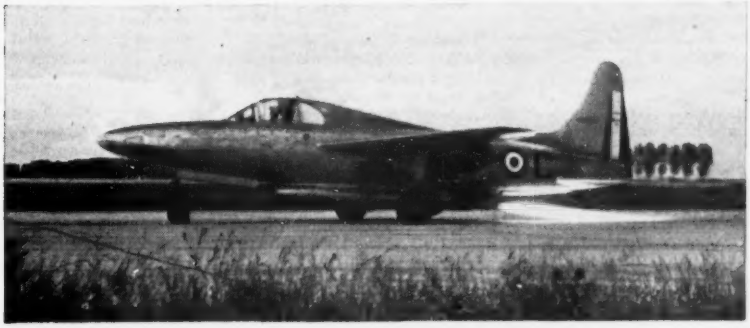


WITH RAMJET AND ROCKET: Power plant of the Leduc 021 research aircraft (top) is a Leduc ramjet, or athodyd. The machine was seen by President Vincent Auriol during his official visit to the Flying Research Centre at Brétigny, near Paris, last month. Like its predecessor, the 010, the 021 is air-launched. Seen testing its S.E.R.P. rocket motor on the ground is the S.O.6026 Espadon, which gave a dramatic performance at Le Bourget on July 5th.

Great Britain

Gloster Javelin. It is learned that the wing area of later Gloster Javelin all-weather fighters (two Armstrong Siddeley Sapphires) will be increased by carrying the leading edge forward slightly, near the wing-tips. This will give a useful increase in wing area, though in view of the Javelin's already low wing loading it is unlikely that this is the only reason for its adoption.

France

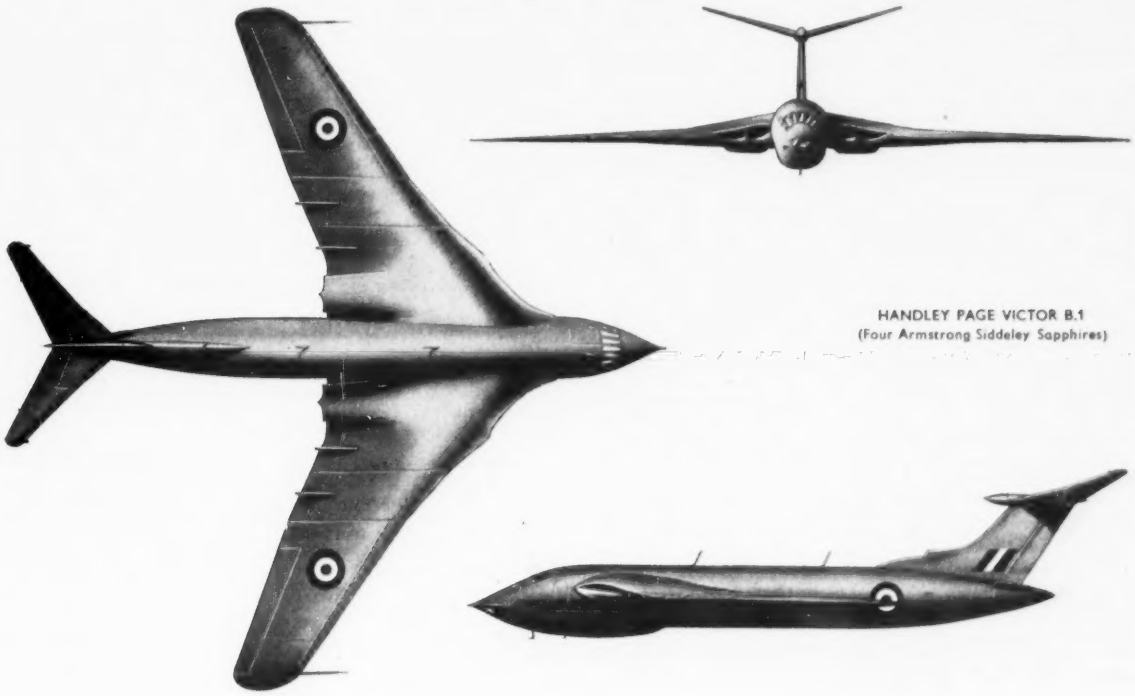
Hispano-Suiza Installations. The following are the principal installations of the Hispano-built versions of the Rolls-Royce Nene and Tay made to date : Nene : S. E. Mistral, Marcel Dassault 450 Ouragan, S.O.30, S.O.6021, S.O.6025, S.O.6026, S.E.2410, S.E.2415, Nord 2200, Bréguet 960. Tay : Dassault Mystère II, three prototypes of the Mystère III, and the Mystère IVA. The Rolls-Royce Avon RA.7 (9,500 lb thrust with reheat) is to be fitted in the Mystère IVB, Hurel-Dubois H.D.45, and S.E.210 Caravelle.

Italy

Licence-built F-86D. The possibility is reported that Rolls-Royce may receive an off-shore contract for the supply of Avon RA.7s for installation in North American F-86D all-weather, single-seat fighters to be built under licence in Italy by Fiat. The first 50 machines or so would have General Electric J47s.

Spain

Current Types. The principal types of aircraft recently developed in Spain are the CASA-201 Alcotan light twin-engined transport (two Armstrong Siddeley Cheetah 27s); the CASA-202 Halcon, a larger twin-engined machine with two Elizalde B-1A radials of about 750 h.p.; the Iberavia I-11 Peque tourer; and the I-115 two-seater primary trainer. These machines are made by Construcciones Aeronauticas S.A., and Iberavia S.A., both of Madrid. While the I-115 is on Chipmunk lines, the Peque (which has been flying for many months) bears a remarkable resemblance to the design of Millicer, Bennett and Tutty which was successful in the Royal Aero Club's recent aircraft design competition. One obvious difference, however, is the installation, in the I-115, of a Continental C-90-12F flat-four engine, whereas the successful British (or rather Australian) design calls for a Blackburn Cirrus Minor.



HANDLEY PAGE VICTOR B.1
(Four Armstrong Siddeley Sapphires)

THE GYROSCOPE in AERONAUTICS

An Explanation of Principles and of Effects—Useful and Otherwise

By A. H. YATES

THE first section of this article serves as an introduction to the subject of gyroscopes in general. It is followed by a summary of particular applications of the gyro principle, which will be of interest not only to readers of the first part of the article, but also to those already familiar with the basic principles involved. The applications mentioned include automatic pilots, unwanted gyroscopic effects, helicopter problems and "flying saucers." The author, a frequent contributor to "Flight," is a senior lecturer in aerodynamics at the College of Aeronautics, Cranfield.

A SPINNING body has several remarkable properties which can be made to affect the control and stability of machines with rotating parts. The aeroplane, whether driven by a piston-engine or turbine, is in this class of machine, and so is the helicopter. A study of these properties will reveal how large the effects are and what steps are necessary to overcome them and may suggest ways in which the behaviour of the spinning body can be turned to advantage in the stabilization of the aircraft.

Basic Principles.—It was Foucault in 1852 who gave the name "gyro-scope" to such a body. He was concerned to demonstrate the rotation of the earth and used (in addition to the pendulum which bears his name) a rotating flywheel which successfully showed the earth's rotation—hence "gyro-scope." The property which Foucault used is known as the First Law of Gyrodynamics and states that a freely supported gyro (for example, in frictionless gimbals) will maintain its axis pointing in a given direction in space. This is, of course, the property now used to provide a pilot with an artificial horizon and direction datum, as in the gyro horizon and the directional gyro.

The Second Law of Gyrodynamics concerns the effect on the gyro axis of an attempt to change its direction. To explain this we must define some axes and, for convenience, let us imagine the gyro axis to be vertically downward (OZ in Fig. 1) and the inner gimbal ring in the vertical plane OYZ. The third axis is OX which, together with OY, is in the plane of rotation of the gyro.* If we apply a torque to the outer gimbal ring about the axis OX the gyro axis rotates, *not about OX, but about OY*. This rotation is called "precession" and its rate is given by the equation:

$$L = I\,\Omega.q \qquad \ldots\ldots\ldots(1)$$

where L is the (rolling) moment we have applied about OX (lb ft)

I is the gyro moment of inertia (slug-ft^2)

Ω is the gyro angular velocity (radians per second) † and q is the resulting angular velocity about OY (pitching).

Similarly, an attempt to rotate the inner gimbal ring about OY by a pitching moment M would result in an angular velocity p about OX where:

$$M = -I\,\Omega.p \qquad \ldots\ldots\ldots(2)$$

A rotation about the gyro axis OZ would, of course, not be resisted and would cause no tilting of the axis.

The sign convention is that Ω, p and q are positive in the cyclic directions X to Y, Y to Z and Z to X respectively. The direction of the precession is governed by the law that the spin axis tends to become parallel to the torque axis with the direction of the spin in the direction of the torque.

If, however, the gimbals are frictionless, motion of the frame attached to the aeroplane causes no precession (or "wander") and the spin axis remains fixed in space.

The Spring-restrained Gyro.—Fig. 2 shows a gyro attached to the frame (aeroplane) by a single gimbal ring which is controlled in its movement by a centering spring. Pitching and yawing of the aeroplane have no effect on the gyro axis but a rolling of the aeroplane (p about OX) applies a rolling moment L to the gimbal which, from equation 1, causes the gimbal to rotate (q about OY). This precession is resisted by the centering springs which now apply a moment to the gimbal (−M about OY) which causes a precession p about OX. Equilibrium is reached in a steady roll when the gimbal is rolling at the same rate as the aeroplane has had a deflection, depending on the spring rate, which is indicated by the pointer. This spring-restrained gyro thus forms an indicator of rate of roll. By exchanging the axes so that the spin axis is horizontal a rate-of-turn or rate-of-pitch indicator is produced.

Gyro Flying Instruments.—The gyro horizon consists of a free gyro, electrically, or air-driven, with axis vertical and the position of the gimbal rings is usually presented to the pilot as the position of a "horizon bar" relative to his airframe—represented by a small model. Since unavoidable friction in the gimbals will cause precession, the spin axis must either be set vertical by eye every ten minutes or so or supplied with a small correcting torque when the deviation becomes appreciable; this is easily arranged. The equations above show that the rate of precession is a minimum for a rotor of high moment of inertia rotating at high speed.

The directional gyro is also a free gyro but has its axis horizontal and only the compass heading of the spin axis is required by the pilot. The single scale reading is supplied to the pilot by a ribbon moving in a window or by a dial presentation of an aeroplane in plan moving relative to a compass card. Again precession is caused by friction and the reading of the directional gyro must be corrected to agree with that of the compass every ten minutes or so. This, too, can be arranged automatically by signals from a magnetic compass (as in the Gyrosyn compass). The rate-of-turn indicator is centred by its spring and needs no correction for precession. There is not, therefore, the same need for very high rotational speed and a direct current electric motor consuming only a few watts is adequate.

Automatic Pilots.—With the aid of the above signals of the aircraft attitude and rate of turn (rates of pitch and roll are not normally measured by spring-restrained gyros but must be judged by the pilot from attitude changes) the pilot finds no difficulty in controlling the aeroplane. He acts as an interpreter of the gyro signals and makes suitable control movements. The automatic pilot is merely a device for performing the same actions; it is fed, electrically or mechanically, with signals from the various gyros and applies control movements proportional to the attitude changes, rates of change and even of accelerations. The gyroscope is the detector which supplies the information that action is needed.

Unwanted Gyroscopic Effects.—The aircraft engine contains rotating parts which are free only to rotate. When the aircraft rotates about an axis other than one parallel to the engine axis gyroscopic couples will be imposed on the aircraft through the bearings. These are unwanted and not only must the bearings be designed to take the extra gyroscopic load but the flying controls of the aeroplane must be adequate to deal with the gyroscopic couple applied.

Consider, for example, an engine rotating clockwise when viewed from astern. When the aeroplane yaws to starboard the Second Law states that there will be a (nose-down) pitching moment given by:

$$M = -I\,\Omega.r$$

where r is the rate of yaw and I is the moment of inertia of the rotating parts of the engine.

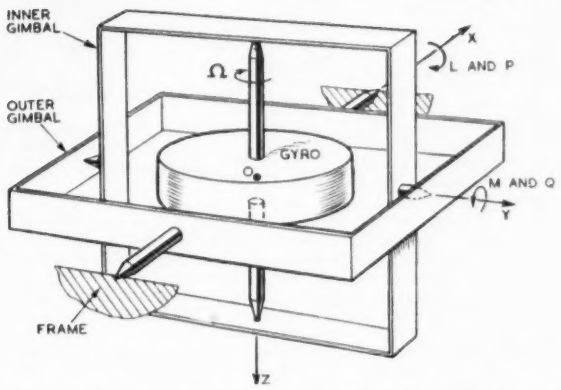
This pitching moment must be trimmed out by the pilot by the use of the elevators and, since a turn normally involves the use of all three controls, this is not a serious handicap. Nevertheless, yawing to port will give a nose-*up* pitching moment and the difference in behaviour when the aeroplane turns to port and to starboard may confuse a pilot. Similarly, a pitching of the aeroplane results in a yawing moment.

APPROXIMATE MOMENTS OF INERTIA AND ROTATIONAL SPEEDS OF ENGINES AND AIRSCREWS

	I, slugs–ft.^{2}	r.p.m.	Product
Large Airscrew (4-blade, 11ft diam.)	50	1,200	60,000
Rotary piston-engine	40	1,200	48,000
Centrifugal turbojet (Thrust 5,000 lb)	10	10,000	100,000
Axial turbojet (Thrust 8,000 lb)	15	10,000	150,000
Helicopter rotor (40ft diam.)	1,500	250	375,000

* *These are the axes used in discussing aeroplane stability; OZ is vertically down, OY to starboard and OX forward.*

† *A slug is a unit of mass, equal in pounds to the acceleration in feet per second^2 experienced by a freely falling body at the place of measurement. Thus, normally, a slug may be said to be a mass of 32.2 lb. A radian is the angle formed at the centre of a circle by an arc equal in length to the radius. Thus, one radian/sec represents* $\frac{1}{2\pi}$ *or roughly 1/6 of a revolution/sec.*



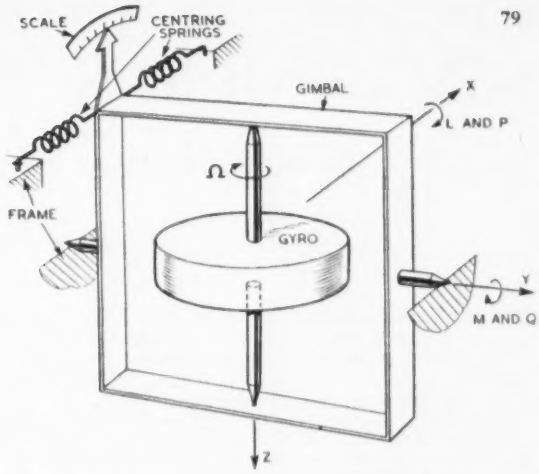


Fig. 1. (Left) A freely supported gyro. The gyro wheel is attached to a frame by a pair of gimbal rings, and the gyro axis remains fixed whatever the movement of the frame. Fig. 2. (Right) The spring-restrained gyro, attached to the frame (or aircraft) by a single gimbal ring controlled by a centering spring. This type of gyro is the basis of instruments indicating rates of roll, turn or pitch.

It will be noted that the magnitude of the moment is proportional to the product of the r.p.m. of the engine or airscrew and the moment of inertia of its rotating parts (see preceding table). The early combination of a rotary engine (almost the whole engine rotating) plus an airscrew rotating in the same direction gave a large value of $I\,\Omega$. Pilots who flew Camels in the First World War remember that the fall of the nose during a tight, right-hand turn was so powerful that almost full control deflections were needed.

The rotary engine eventually disappeared and the moment of inertia of the rotating parts of the later piston engines remained small. That of airscrews got much larger, and the inertia and speed of revolution of present-day airscrews are of the same order as those of the old rotary engines. The inertia of the aeroplane has, however, also increased and the gyroscopic effect on the whole aeroplane, even of several piston engine-airscrew combinations, is small. It is further reduced if contra-rotating airscrews are fitted.

The change to turbine engines has led to high rotational speeds with moments of inertia which are less than those of an airscrew but are, nevertheless, considerable. The product of the two indicates that gyroscopic torque from the pitching or yawing of a turbojet may be several times as big as that from a modern airscrew. The turboprop combination could thus give high gyroscopic forces but, in practice, the directions of rotation of the turbine and airscrew are arranged to be opposite.

The gyroscopic couple also depends on the rate of yawing or pitching to which the aeroplane is being subjected. This probably reaches its greatest value during the spin when it may reach 5 radians per second. Similar values are likely during aerobatics (e.g., a stalled turn) both in yawing and pitching, but the greatest rate of pitching (q) occurring in a pull-out is unlikely to exceed 1 radian per second. Since the engine bearings are designed partly by the gyroscopic load it follows that an engine designed for an aerobatic aeroplane is unnecessarily strong, heavy and expensive for a large, civil aeroplane on which aerobatics and spinning are prohibited.

Accidents to Comets in which a nose-up attitude was reached during take-off are unlikely to have been connected with these gyroscopic forces. The four Ghost engines rotate in the same direction and each has an $I\,\Omega$ of about 6,000 slug-ft^2/sec. At a steady rate of yaw of 0.2 radians per second (equivalent to motion in a circle of only 500ft radius at 100ft/sec) the nose-up pitching moment is:

$$M = 4.I\Omega.r$$
$$= 4 \times 6{,}000 \times 0.2$$
$$= 4{,}800 \text{ lb ft}$$

On an aeroplane as large as the Comet this moment would be developed at 100ft/sec by only one or two degrees of down elevator movement. In any case, the occurrence of a prolonged turn during the take-off is very improbable. A series of swings of the nose from side to side would result in a series of pitching moments up and down which we have shown to be of a size unlikely to worry the pilot.

Nevertheless, the interconnection of longitudinal and lateral controls on any vehicle makes the pilot's task complicated. There are some aerodynamic couplings between the two (e.g., rudder application sometimes leads to a nose-down moment) and these can usually be avoided, but the gyroscopic coupling is avoided only if the engines are handed; that is, if two engines rotate clockwise and two anti-clockwise. In this case there is no resultant gyroscopic moment on the aeroplane, although the bearings still have to carry gyroscopic loads.

Helicopters.—Some interesting gyroscopic problems arise in the helicopter rotor. A typical helicopter rotor has a value of $I\,\Omega$ of 40,000 slug-ft^2/sec, so that any attempt to tilt the shaft will result in a very small precession; alternatively, very large external moments will be required to obtain the rotor tilt necessary for helicopter control. In fact, the blades are usually universally jointed to the hub and the disc can be tilted by the use of an aerodynamic servo—that is, the feathering of each blade so that the aerodynamic force generated does the necessary work. The control problems are thus not so formidable as they appear.

A recent paper by Fitzwilliams§ suggested that, for a large helicopter, the rotor drive might be supplied by turbojet engines mounted with the axes across the blade tips. Each turbojet would then be yawing at the angular velocity of the rotor, say 10 radians per second, so that very large gyroscopic couples would be applied to the blades, tending to twist them. In addition to the gyroscopic load on the turbine bearings the centrifugal load would be equal to that during a pull-out at about 200 g. If the turbojet were placed so that its axis lay *along* the blade (the entry duct and jet pipe turning through 90 deg) the gyroscopic moment would apply a bending moment to the blade which could be arranged to relieve the bending moment due to the blade aerodynamic loads. The centrifugal load on the bearings would then be taken on thrust bearings.

The existence of the gyroscopic properties of a rotor are made use of in the "Bell bar." The Bell bar consists of a set of weights rotating with the rotor and forming a gyro. Any change of attitude of the helicopter fuselage does not immediately affect the plane of this gyro, which tends to remain fixed in space, since the fuselage is universally jointed to the rotor. The tilt of the fuselage relative to the disc is measured by a lever system attached to the rotating Bell bar, and this applies appropriate feathering to the rotor blades which cause a disc tilt until the chosen attitude of the disc to fuselage is regained. The rotor is thus made the gyro of an automatic pilot.

"Flying Saucers."—An account which appeared in *The Times* of April 22nd, 1953, described a projected "flying saucer" aircraft in which "use is made of the gyroscopic effect of a rotating power plant to acquire stability." If the power plant rotates in one direction only about a vertical axis which is rigidly locked in the airframe, then a pitching disturbance induces a rolling disturbance. Similarly, a rolling disturbance causes a pitching motion. If, however, the power plant had two elements rotating in opposite directions (having equal $I\,\Omega$) the precession effect would be zero and the interconnection between rolling and pitching eliminated. The gyroscopic effect would then be to stabilize the oscillations of the aircraft. This effect of a gyroscope rigidly connected to an oscillating body has been studied in connection with mono-rail cars** and it has been shown that a car having its centre of gravity above the rail will be stable if a vertical axis gyro has sufficient angular momentum.

The "flying saucer" might well have little aerodynamic static stability and the contribution from the gyroscope could then be of importance.

§ *"Journal of the Helicopter Association," Vol. 5, No. 4* (1952).
** *See, for example, Ferry: "Applied Gyrodynamics," page 259. John Wiley,* 1932.

SOME RUSSIAN HISTORY

Faint Pages from the Past in a Biography of Jukovski

By MAURICE F. ALLWARD

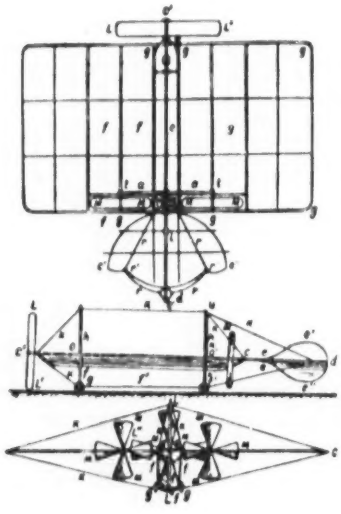
IT is not often that *Flight* reviews a book that readers will not be able to buy, or even borrow from a library. We make an exception in this case because the book—of Russian origin—is one of the few aeronautical publications of that country to become available for scrutiny.

The book, a biography of the Russian pioneer Nicholas Jukovski, is a product of the U.S.S.R. War Ministry and is written by Col. A. A. Kosmodemianski, Doctor of Physical-Mathematical Science and Professor of Military Engineering. It is one of a series issued to young members of the three armed Services; and, as might be expected, much of it is propaganda—naive and heavy-going to the Western mind.

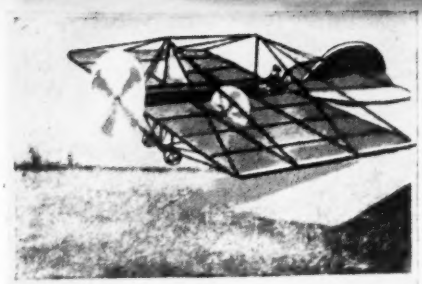
Measuring 5in by 8in, the book is paper-covered, and contains 136 pages and carries 46 illustrations. The standard of printing is high but the photographs—mostly of bearded Russian pioneers—are, by contrast, faint and dull. There are nine chapters, the first of which comprises the introduction; chapters two and three cover Jukovski's school and university days, and No. 4 deals with some of his early work on the subject of hydromechanics.

Of greatest interest is chapter five, sub-headed "From the History of Aviation in Russia," for in addition to giving an impression of the official Soviet view on aviation it provides—just as the Western World prepares to celebrate the 50th anniversary of powered flight—further information on the Russian claim to have beaten the Wright brothers by some 20 years. The second paragraph of this chapter gets well into the swing of the spirit of things with, "Our land saw the origin of the dirigible, helicopter and aeroplane. Our land saw the first aerobatic flying on propeller-driven as well as jet aircraft. The Russian scientists were the originators of aerodynamics, the theory of reactionary movement and of high speed aerodynamics." As if this were not enough, on the next page the reader is informed that it was Jukovski who "established the true scientific principles of aviation," and that "by making use of these principles, scientists in other countries are *still* [our italics] getting new and helpful technological results."

Seaman A. Mozhaiski is the person credited with the world's first powered flight. Apparently Mozhaiski learnt to fly in 1880 on huge kites towed by three horses or, as the book states, "Powered by three-horse animal mechanical power." In the same year it is claimed that a patent was applied for, and granted in 1881, for an aeroplane incorporating a surprising number of advanced features. As can be seen from the illustration reproduced on this page and claimed to be from the original patent specification, the aircraft "embodied all the basic features of a contemporary monoplane" and incorporated the following features: (1) a fuselage (literal translation "boat") for pilot and engine; (2) two fixed wings; (3) an elevator and rudder; (4) a large front propeller; (5) two smaller propellers near the trailing edge which helped to reduce the size of the front propeller and at the same time differentially to assist steering; (6) an undercarriage setting the wings at an angle of attack of 4 deg; (7) two kingposts, which not only braced the whole aircraft, but also provided "for movement of tail."



A copy of the drawing said to have been filed with Mozhaiski's patent in 1880. Although the use of Roman lettering may appear surprising, this was already standard practice in patent specifications at that time.



The original caption to this drawing reads: "Picture of the first aeroplane in the world, constructed by A. Mozhaiski."

Рис. 19. Чертежи, приложенные к патенту, и первый в мире самолёт, построенный А. Ф. Можайским

In working out the engine power required for his aircraft, Mozhaiski calculated the power required to turn a ship's propeller in water and, then relating these findings to the relatively low density of air, concluded that 30 h.p. would turn his propellers at the necessary speed. His first engine, a bought-out item, was no good, and so in true pioneering fashion he set to and designed one himself.

The book stresses that Mozhaiski constructed his aircraft "unaided," in the face of severe difficulties. No help came from either the government of the day or from any of the technical societies in being at the time. In common with other scientists under the Czar, he worked at his "own financial risk."

Mozhaiski completed his engine in 1881 and it produced the desired 30 h.p. for a weight of 150 kg. It was steam-driven, with twin vertical double-acting pistons. The steam passed from one cylinder to another and was thus used twice before discharge to the atmosphere—a compound engine in 1881!

It is reported that during the trial flight the aircraft left the ground and flew some distance before landing and breaking a wing. This mishap so annoyed the government officials present that the machine was dismantled and destroyed, and all reports of the trial suppressed. The original drawings were filed in the archives of Leningrad, and there they remained until their recent discovery. "Only now," the book states, "can the work of this pioneer be revealed," and continues, "We have the full right in being proud of this mighty Russian achievement and say to the whole world, the aeroplane is a Russian invention."

Before one dismisses this claim with the usual impatient shrug, it is worth while remembering that around this time, here in England, it was only bad luck that snatched success from Sir Hiram Maxim, and there seems little doubt that in France Ader *did* make a short flight on October 12th, 1897. And, as far as America is concerned, it took over 40 years for the Wright brothers' claim to be "officially" recognized; the honour, up to 1948, was accredited to Langley!

Another first claimed for Russia is the first stratospheric balloon, thus: "In 1875 Mendelayeffe proposed the construction of a high altitude balloon, with a hermetically sealed gondola. THIS WAS THE FIRST STRATOSTAT IN THE WORLD. Mendelayeffe refers to this idea of his in a series of papers. It is quite wrong when technical and scientific literature ascribes priority in developing the stratostat to the Belgian Picard [*sic*] who developed his project 56 years later."

People familiar with conditions in Russia just before the turn of the century concede that students of the day had a remarkable aptitude for discussion and theorising on a wealth of subjects. It is thus quite probable that some of the papers read at the numerous scientific meetings anticipated technological developments in other countries. It is difficult to assess the actual credit that should be given to these early papers, however, as many were obviously wild shots in the dark and of no more practical use at the time than some of Leonardo's sketches were to his contemporaries. Though there might be truth in the claims for Mendelayeffe's theorisings no mention is made of any attempt to construct his "hermetically sealed gondola"—an unusual omission if he did, in fact, make one that was successful.

The lack of useful practical work carried out in Russia at the time is mentioned in the book. What practical work there was, was not systematic. All construction was by "hit-or-miss" methods. Mendelayeffe appreciated this and perhaps his real claim to fame is that apparently he stressed the importance of collecting "facts by systematically arranged scientific experiments" and that his "noteworthy works indicated the right direction for further scientific investigation into the problems of aviation."

Chapter six deals in rather surprising detail with the early theoretical work of Jukovski; chapters seven and eight cover his work on "Experimental Aerodynamics" and "Practical Aerodynamics" respectively. The latter makes strange reading for a biography on Jukovski and brings in "Myeffski," credited with "creating the scientific basis of the technique of artillery," and Ziolkovski, who "created the scientific basis for rocket technology." Ziolkovski certainly lectured and wrote articles on rockets in the 1890s and covered ground which Oberth re-covered 30 years

(*Concluded on page* 84)

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PARISIAN ROUND-UP

In the Salon Static Show: What Foreign Equipment Manufacturers are Doing

FOLLOWING upon the account of the aero engines at the recent Paris Salon, which appeared in our last issue, we now present a report of the more interesting accessories which were on view. Though this report will deal with many developments in some detail it is in no sense intended to be a catalogue of all that was shown. With one or two exceptions—exhibits on which information was not available earlier—the well-known products of British firms are not again dealt with here; they were reviewed in our guide to the Paris Show in the issue of June 26th.

Altogether, the Paris static show was well worth close study and vividly illustrated the design fertility of the French aircraft industry's second line—the sub-contractors and accessory-makers. Bearing in mind that the majority of these firms had to start from scratch in 1945, it is instructive to note which concerns have developed complex products of their own, and which have deemed it wiser to produce British or American equipment under licence. The majority chose the former course, for it is natural for a factory to have its own design office, particularly in a country with such national pride as France. To some extent this is a handicap to the NATO scheme of things, for some of the French products—electric cables, screws, sockets, tyres and the like—are not interchangeable with the standard items as at present used by the various Allied Air Forces. But whether this state of affairs will be rectified or not, the fact remains that the French have designed, and are attempting to mass-produce, a large range of purely national products. At any rate, whether the equipment is of French, British or American design, it seems likely that everything inside current French airframes will bear the name of a French manufacturer.

We have selected the following stands as being those exhibiting developments of a particularly important or novel nature.

Aerazur.—One of the biggest French producers of safety equipment, Aerazur showed a wide range of parachutes for all purposes. A particularly interesting exhibit was the S.N.C.A.S.O. ejection seat, which has been standardized on all the latest French high-performance aircraft. This seat owes a great deal to the pioneering developments in this country by Martin-Baker, Ltd., but it appears to be a rather simpler and cheaper product. The seat displayed was not of the fully automatic type, although Aerazur, who market the seat for S.N.C.A.S.O., state that such a development is now in hand. Aerazur also showed a standard *armée de l'air* anti-g suit, and its associated pneumatic system.

Air-Equipement.—This is one of the biggest of all French accessory manufacturers and is currently producing a great range of pneumatic, vacuum and fuel-system components and various types of electric generators and starters. Additionally, the company manufactures much British and American equipment under licence—in particular, products designed by Lucas-Rotax, Automotive Products and Bendix.

From the last-named firm were a number of miniaturized, low-inertia electric motors and instruments, and Automotive Products designed much of the equipment fitted in the Mistral; but the most prominent licence-produced equipment was that from Lucas-Rotax, among which one of the latter company's cartridge starters was well to the fore.

AiResearch.—For many years this Californian company has developed low-pressure air systems to meet every possible airborne auxiliary-power demand. Of late, a range of gas-turbine compressors has been introduced for both ground and air use, made up into neat "packages" weighing about 180 lb each, which can be used to supply either, or both, compressed air or a shaft drive. A typical installation is that which provides compressed air for starting a large fighter power-plant. In this case, the gas-turbine compressor might be mounted in one of the tip tanks, where it could be supplied with ram air and any suitable fuel, probably the same as that used by the main engine. Thirty per cent of the compressor air would, for starting purposes, be drawn off at 350 deg F and 45 lb/sq in and passed through suitable hosing to the air turbine starter mounted on the turbojet. The whole installation should not weigh more than about 230 lb, which AiResearch consider not to be excessive. Starters of this type are being used in later types of F-86 and will be overhauled in this country by Sir George Godfrey and Partners, and Normalair.

Also shown was a novel ram-air turbine, which is designed to drive an emergency hydraulic pump to serve power-control systems in the event of complete engine or hydraulic failure. It is a variable-pitch windmill of 14 or 15 in diameter, self-governing to its correct speed by internal fly-weights at the blade roots. Capable of delivering full power at any speed between 130 kt and Mach 1, the unit is typically placed in the rear fuselage, in an air duct fitted with controllable doors.

Another new development was a singularly neat cabin-pressure regulator which combines the whole system into one unit on the pilot's control panel and needs no external power source. This was indeed an unusually compact device and could be compared with a similar development by Normalair which was discussed on June 26th.

Andyar.—This is the French company of the group manufacturing lightweight silver-zinc accumulators developed by André Yardney; the corresponding British firm is Venner, Ltd., who, of course, produce the well-known Silvercel. The alkaline accumulators shown were described as the smallest and lightest batteries in the world and in the main were manufactured by Yardney Electric Corporation of New York.

Arena.—The great variety of miniaturized variable condensers showed a commendable standard of workmanship, even though the exhibits were taken straight from the company's production lines. This, one of the smaller French companies, was obviously standing entirely on its own merits.

Bendix.—The Bendix Corporation is one of the largest companies in the whole American industry and embraces almost every field of aircraft accessory. Two new developments in wheel brakes were the segmented plate brake and the Cerametallic brake lining. The former utilizes rotating members of substantial thickness, with considerable thermal capacity. The discs are not continuous but are made up of segments flexibly attached to one another by leaf springs, and keyed to the wheel around their outer periphery. Advantages claimed are an increase in heat-absorption capacity and internal ventilation, and freedom from jamming or wearing of the rotors. It has been found that for a given braking torque less hydraulic displacement and pressure are necessary and a further claim is that the presence of water—or even oil or hydraulic fluid—does not seriously impair braking efficiency.

The Cerametallic brake lining is a sintered compound which is made up in the form of circular pads retained within metal cups, mounted around the periphery of the stators of any multi-disc brake. The Cerametallic lining has much better heat-conduction properties than the resin-base materials usually used, but can also operate at sustained temperatures up to 2,000 deg F. An extremely lengthy list of advantages resulting from use of the new material is claimed, including "50 per cent greater brake capacity; five times longer lining life; and relining time cut in half."

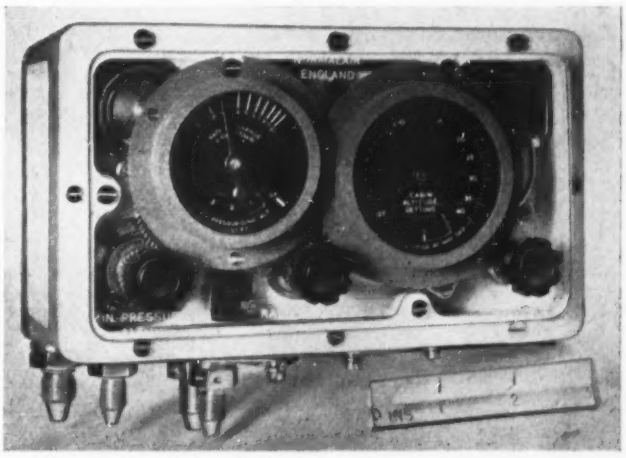
Bendix Radio showed the type NA-5 distance-measuring equipment. The interrogation and reply frequencies are of the order of 970 and 1,200 mc respectively and the range indicator is calibrated on two scales graduated from 0-40 or 200 miles, 200 nautical miles being the maximum range. A recent development is the fitting of two belly aerials sloping diagonally downwards to give a good signal when the aircraft is banked. Another radio development was the flush A.D.F. loop which, being of the magnetic type, is claimed to be insensitive to disturbing electrical fields. The loop was also stated to have three to four times the sensitivity and signal noise ratio of contemporary loops.

The largest Bendix exhibit was a telemetering ground-station which was shown actuated by airborne transmitting equipment mounted on a model aircraft. In a normal arrangement a pick-up mounted on a missile would oscillate a sub-carrier oscillator, in the band from 400 cycles to 70 kilocycles in standard equipment. This frequency modulates a miniature two-watt transmitter of very rugged construction operating in the frequency range of 215-230 mc. The transmitter uses four miniature valves and weighs 0.92 lb including case and connectors.

Bréguet.—It may be remembered that in 1944 the Blohm und Voss company of Germany developed a glider bomb—the Bv 246—which employed a high-aspect-ratio wing made of reinforced concrete. Louis Bréguet has now developed a more advanced concrete wing which, unlike the German pattern, is hollow. The example shown at Paris had a root chord of about 2ft and a minimum wall-thickness of less than 1in. A steel mesh, or perforated sheet, is used as the basis for the wing and this becomes progressively stronger towards the root, finally ending in machined stainless steel root fittings. The painted surface of the wing was commendably free from irregularities. No information was forthcoming regarding the wing's application to production missiles.

Bronzavia.—An indication of the growth of the French industry is given by this firm which, before the war, produced little but carburation and fuel equipment and exhaust stacks. At Paris they showed a variety of radio, optical, electro-mechanical, fuel-injection, refrigeration, oxygen and other equipment, including turbo alternators, air compressors and complete fuel systems. Bronzavia are also carrying out much sheet-metal sub-contract work of a high quality; a Nene tail-pipe (for Hispano Suiza) seemed to be fully up to the standard of British-made equipment, the seam welding, in particular, being excellent. A tailplane-tip for a Dassault Ouragan was also shown, made from light-alloy pressings seam-welded along the extreme edge.

This revealing exhibit on the Normalair stand showed the new Type D pressure controller, mounted in a transparent case.



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Curtiss-Wright.—Even more massive than their engines (described last week) was the Model 501 instrument-flight duplicator, constructed under Dehmel patents. This is "an integrated package of six components which contain all controls, instruments, flight-simulating devices and radio navigation aids needed for training a student in solving any operational problem possible in any 0-250 knot airplane." Unlike Link trainers, the Dehmel designs are fixed rigidly to the floor of the room in which they are housed. Earlier products referred to specific aircraft—B.O.A.C., for example, use Curtiss-Wright simulators on the Stratocruiser—but the Model 501 can be adjusted to represent any current piston-engined airliner. The unit is entirely electrical in operation and is claimed to be very trouble-free in operation, without time-consuming regular maintenance checks. Its utilization can be further enhanced by the addition of a radio-procedure training consol, which combines V.O.R., D.M.E., A.D.F., and I.L.S. The ultimate aim of the Model 501 is "instruction on the ground and practice in the air."

Curtiss-Wright also exhibited Turbolectric airscrews and a number of extruded hollow steel blades which are a major development.

De Havilland.—The centre-piece of this stand was an advanced design of constant speed, feathering and reversing airscrew for gas turbine engines of up to 1,800 h.p. Designed principally for the Vickers Viscount, this airscrew incorporates accurate constant speed changing, two-second feathering, rapid and closely controlled rate of pitch change and hydraulic emergency pitch locking. Four solid duralumin blades were used, of conventional section and profile, and the diameter was 10ft 6in. De-icing was not fitted on the actual airscrew exhibited.

Dunlop.—This stand was prepared by the French branch of the company, although many items developed at Coventry were exhibited. Outstanding was a complete Comet main wheel fitted with one of the new dimpled tyres. This tyre, which seems to be one inch narrower than that normally fitted, has a smooth surface except for a number of small craters or dimples which are provided principally to given an indication of wear. B.O.A.C. speak highly of these tyres, which are stronger and last longer than the ribbed pattern formerly fitted.

Not seen before was a fuel-tank pressurization valve supplied by air tapped from the main engine compressor at pressures from between 6 to 300 lb/sq in. The valve maintains constant output pressure, the delivery being up to 70 cu ft of free air per minute.

Another prominent exhibit was the air intake to a Rolls-Royce Dart, as fitted to the Viscount, for which Dunlop provided electric-thermal de-icing. The intake had been partially stripped of its rubber surface layer in order to show the efficient heating elements underneath.

E.C.A.—The Etudes et Constructions Aéronautiques stand was adjacent to that of Jean Turck, who deal in telemetering equipment. Turck stated that E.C.A. made "the best guidance systems in France," so we examined their stand closely. Unfortunately, little was forthcoming regarding principles of operation, but the centre-piece was a model missile whose gyrations were controlled by a moving spot of light on the wall, the missile nose having a photocell whose signals actuated a three-axis autopilot.

A missile-guidance "beep box" was also connected to the same model, this having a conventional "stick and rudder" fingertip arrangement. Another demonstration panel carried three servo-mechanisms—one each for speed, position and force—which were stated to be used in conjunction with ground signals for the stabilization of missiles.

E.F.A.—Etudes et Fabrications Aéronautiques are another maker of safety equipment. Specializing in parachutes, they showed various types of personnel, troop and supply packs, and braking patterns, the latter being of the ribbon variety. These were all of E.F.A. design. Built under licence from an "unknown" American company was the Type 10 anti-g suit, which was shown clothing a dummy; the suit automatically inflates and deflates in a controlled manner at accelerations in excess of 2g. A particularly ingenious device was the company's quick-release catch for a safety belt or lap-strap; but it appears to require previous familiarity for easy manipulation—a grave disadvantage for airline use.

Elveco was another company exhibiting high-quality variable condensers. Several basic types were shown, some with a linear voltage/capacity characteristic and many stressed for use in missiles.

Fauré Herman.—Among a variety of electric tachometers and flow-measuring devices was one which appealed greatly. For measurement of fluid flow, the equipment consists of a simple fan with two of its four blades magnetized, mounted in a constant diameter tube. As each magnetic blade passes a solenoid, mounted to move radially just outside the pipe wall, the latter is attracted and feeds a signal to a remote box. The box responds to "kicks" and, after accepting 14 such impulses, responds on the fifteenth. Fifteen kicks from the solenoid correspond to one litre in the example we saw.

The beauty of the arrangement is that virtually no power is absorbed by the fan, so greatly reducing errors. The model examined was roughly eight inches of two-inch pipe, and could pass up to 30,000 litres (6,600 gal) per hour, with an accuracy better than one per cent.

Fermeture Eclaire was found to be a licensee of a well-known British company, namely, Marston Excelsior. On view were flexible bag-tanks, marketed under the name "Flexelite," cellular and laminated plastic components, and a Marston heat-exchanger.

Filotex arranged a most attractive stand with specimens of electric cable, chiefly of the metal-braided or P.V.C.-coated type. Co-axial cables and multi-wire types were also shown, and leads for antistatic aerials.

Fokker.—Apart from their main aircraft stand, Fokkers took an auxiliary stand for their Fokker-Eckold universal sheet-metal shaper. This looks much like a small press or riveter or spot-welder. Actually the machine has a head and an anvil, both of which can be fitted with special tools which, essentially, consist of two halves—left and right—which slide sideways when the two heads are pressed together. The tools can either slide open or closed, according to whether they are used for stretching or shrinking. We ourselves spent a few minutes manipulating a piece of one-inch angle into various shapes, and learned that, with practice, such complex pieces as pipe-junctions could be made from flat sheet, by forming two halves which were then seam welded together. For light work, hand-operated stretchers or shrinkers are available. The machine is in production.

Helice Legère.—The principal aim of this company, as its name implies, is the development of lightweight airscrews and helicopter rotors. On their stand they showed a number of airscrew blades utilizing various types of construction—in particular, of laminated wood with a plastic protective coating. There were, however, a number of blades formed entirely from asbestos-bonded resin-based plastic. The type EF.10 two-blade airscrew shown weighed but 44lb; this type of airscrew is used in the N.C.856 air observation post and thus absorbs some 220 h.p. It has laminated-wood blades whose pitch is variable by a manual linkage to the cockpit.

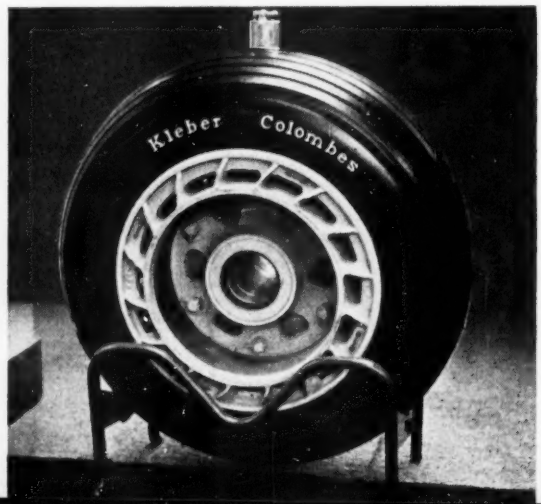
Jaboreva.—On this stand was a new machine tool developed by the company and designed to produce bulkheads or dishings from sheet or strip. Essentially it consists of a number of rollers whose relative positions and angles can be accurately adjusted and a central pivot on which the work could rotate. For certain types of work, specially made rollers would be required but with the standard pattern most types of work should be capable of easy manufacture. Two unusual features of the machine are that the work need not be circular in plan form—an eliptical shape being quite easily achieved—neither need the turned-up edge be at 90 deg, for a specimen workpiece formed from straight strip had a turned-up angle varying between 70 and 100 deg in a controlled manner throughout its length. The maximum thicknesses of metal which can be handled are 4mm Dural and 2-3mm steel.

Jacottet.—By far the most important products from this company are hydraulic power controls of the type used in—among other aircraft—the Arsenal 1402, Leduc 016, Mystère IV, S.E. 5000, S.O. 4050, S.O. 6021, and S.O. 9000. These servo-systems, which are made under licence from R. Leduc, are unusually simple and irreversible and retain the direct manual control for use in emergency. A demonstration rig was mounted on the Jacottet stand with which visitors could amuse themselves trying to disprove these claims. Synchronization appeared to be perfect and the fidelity of the system was unusually good, although, of course, pipe lengths were much less than they would be in a genuine aircraft installation. Operating at a pressure of 147 kg/sq cm (2,080 lb/sq in), one of these control systems recently completed a million cycles without trouble, while another has undergone a lengthy period of severe testing in the S.O 6021.

Kléber-Colombes.—The principal product of this company consists of tyres for all types of vehicle including aircraft. Illustrated on this page is a mainwheel unit for the S.O. 9000 Trident rocket fighter and it was noteworthy that the diameter of the tyre was no greater than that used in the M.S. 755 Fleuret trainer, which weighs, fully loaded, about one-eighth as much. The Trident tyre is in fact the highest-pressure unit yet attempted in France and is a multi-ply unit of nylon and special heat resisting rubber. Also produced are production tyres for the Vampire, Mistral, Ouragan, Mystère, Thunderjet and Sabre, the latter being spares for NATO.

Another more recent development by the company is a low-density foam substance known as Klégécel, which sets hard and combines a variety of uses in aircraft construction. A cube with sides of one metre

The S.N.C.A.S.O. ejection seat (left) was exhibited by Aerazur. The similarity to the Martin-Baker design is obvious.



The tyre/wheel unit (right) is that for the main undercarriage of the S.O.9000 Trident rocket/turbojet fighter. The cigarette lighter on top gives scale; tyre-pressure is to be some 240 lb/sq in when the Trident's rocket-fuel tanks are filled.

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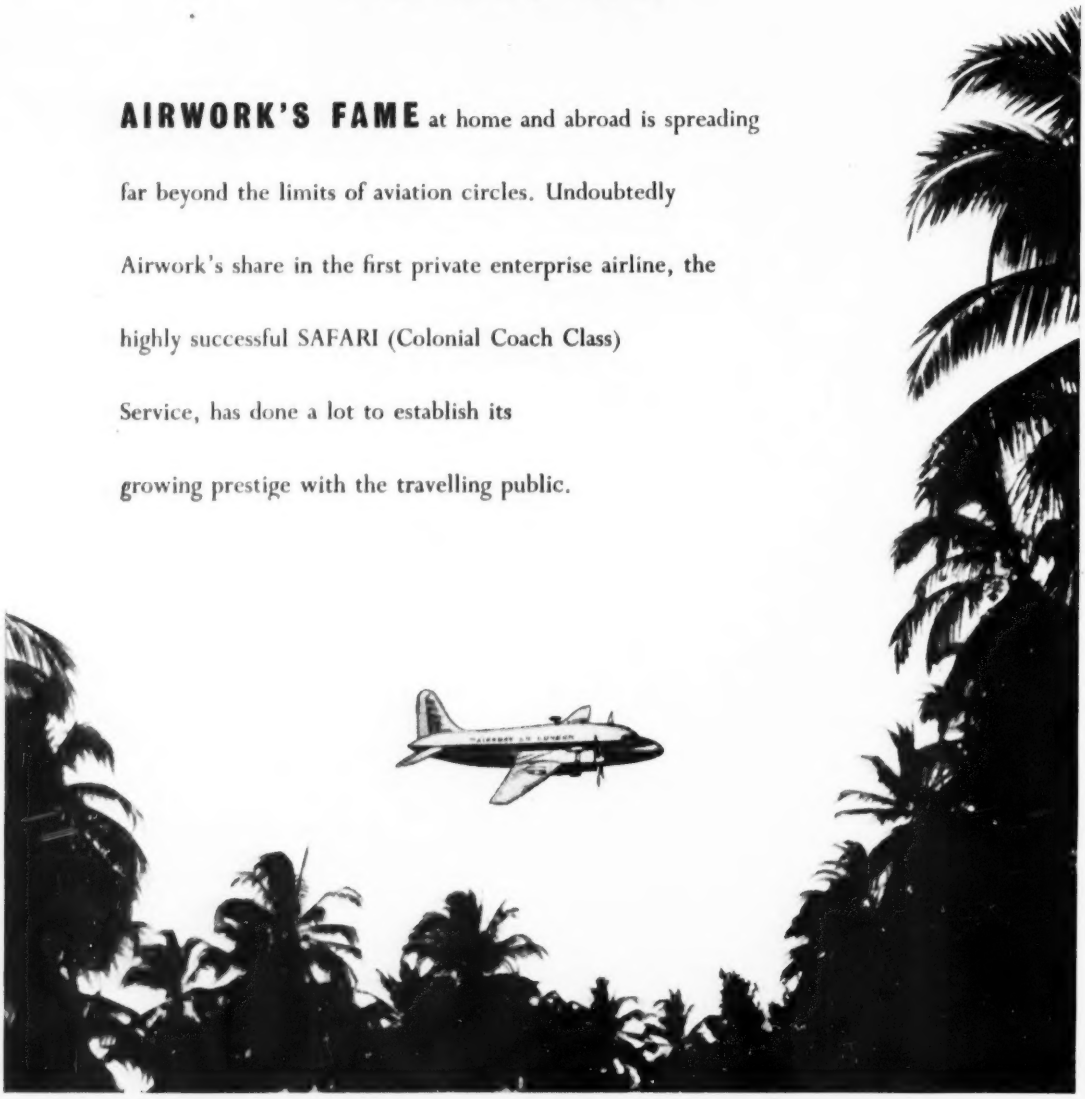

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stood on a scales which read 37 kg (81 lb). A typical application which was shown on the stand is the manner in which Klegecel has been used to provide a smooth interior to the tank bays of a number of modern fighters, including the Ouragan. The basic wing structure here consists of flat sheet with internal angle section stiffening members. These have a depth of roughly an inch and the spaces between them are filled with Klegecel, which is then finished off flush with the tops of the stiffeners; the smooth surface resulting from this process being quite suitable as a basis for flexible bag tanks. Klegecel is claimed to be completely unaffected by any of the liquids normally found in, or associated with, aircraft. This cellular material also finds aircraft applications in the sphere of heat and sound insulation.

Labinal.—A private company concentrating principally upon the development of electric power equipment, Labinal showed some well-engineered pre-fabricated cable assemblies, junction boxes and relays of the type fitted in the Mystère 2. A wide variety of generators was also shown, that for the Mystère 2 and Nord 2501 for example, delivering 6 kW at 28.5 volts between 3,150 and 8,000 r.p.m., the weight being 46 lb. The Mystère 4, on the other hand, has a generator of but 4 kW capacity weighing 35 lb; and a roughly similar generator was shown developed for the French-built Sea Venom, together with earlier models for the Vampire and Mistral.

Labinal also are licensed to sell—and later to manufacture—electrical equipment designed by the American firms of Jack Heinz and Hartmann, and a wide variety of these firms' products was on view.

L.C.T.—The Laboratoire Central de Télécommunication showed their recently developed D.M.E. unit which operates in the 1,000 mc band. The present interrogator and receiver linkage has a maximum range at altitude of the order of 190 miles, and tests are proceeding in a number of French aircraft with a view to getting the system adopted by the French Government.

Le Bozec.—Among a wide variety of fuel system components were several valves with their associated electric actuators. Designed for insertion in pipes of from 1 to 2in bore, these valves had unusually thin metal discs in place of the more normal built-up butterfly type valves. Oil and fuel filters of various patterns were also shown.

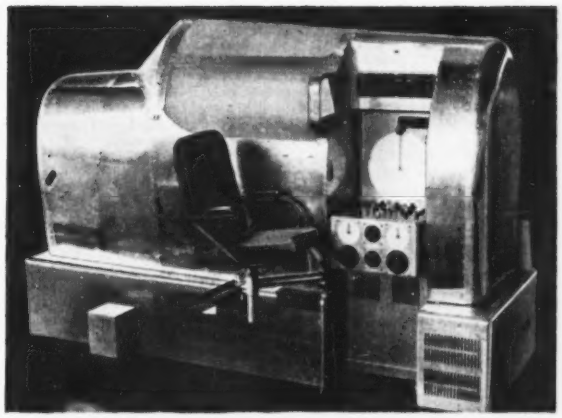
L.M.T.—Le Matériel Téléphonique is a French partner in a world-wide telecommunications network. On their stand was a variety of quartz control V.H.F. R/T. equipment and A.D.F. apparatus. Thermisters and transistors were shown, some employing germanium crystals. A prominent exhibit concerned the V.O.R. equipment developed by Lorenz in Germany which consists basically of a 50-watt transmitter in the 108/118 mc band; a 50-watt stand-by set with automatic switch-over; a 200-watt amplifier; and 50-watt transmitter for *en route* installation. The Lorenz company has developed an unusually flexible system which they call V.O.R./FLEX which can be built up from 50 watts to a full 200 watts facility with stand-by equipment simply by adding standardized packages. Lorenz assume that their equipment will be chosen as the standard navigational aid for the European airway system as envisaged by I.C.A.O.

Magnesium Industriel.—Among the many magnesium castings exhibited was an excellently finished canopy frame for the French-built Sea Venom. Like that of the British-built two-seat Vampires and Venoms, this canopy is a precision casting in a magnesium-base alloy and the example shown was taken straight from the factory without preparation as a special exhibit. Additional magnesium castings were shown of the type supplied to Hispano Suiza for the Nene; adoption of this material has reduced the weight of the Nene by some 100 lb as compared with the first British-built version.

Messier.—The largest exhibit by this famous undercarriage maker was the main leg for the Nord 2501 which was an all-steel welded unit with an excellent finish. For comparison the main and nose legs of the Mystère 2 were exhibited alongside. The standard Messier plate brakes employ multiple discs of chrome-iron while the wheels were universally magnesium alloy casting machined all over. The exhibition wheels in fact were standard production pieces although they had the appearance of special show-piece models. A particularly interesting development was the new anti-skid device which is being marketed under the name of Ministop. The device consists of an accelerometer—a free mass rotating with the wheel—together with a centrifugal governor and an associated electrical circuit. The general principle of operation is very similar to that of both the Dunlop Maxaret and the Westinghouse Decelostat and extensive testing in a MD 315 aircraft under French government supervision has given favourable results. We were told that the Ministop would be produced in this country by the British Messier, Ltd.

Ministere Marine.—This large stand which, as in previous years, was guarded by sailors wielding picturesque halberds, exhibited two experimental missiles both of which were briefly referred to in our issue of July 3rd. The first was an experimental test vehicle developed by the ballistics and aerodynamics laboratory at Vernon, just down the Seine from Paris. This was propelled by a by-fuel rocket, the fuels being strong nitric acid and gas oil. These fuels were carried in chrome molybdenum tanks of 370 and 165 litres capacity respectively. The fuel is blown from the tanks by steam from a generator delivering at 600 deg C and 390 lb/sq in pressure. The nitric acid circulates in a double section around the centrifugal combustion chamber to confer some cooling. The combustion chamber itself operates at 3,000 deg C, and pressure of 285 lb/sq in, the fuel flow being 44 lb per second and the efflux velocity 6,600ft per second.

The other missile was the black-and-yellow S.E.1522 glider bomb, which has been developed as an air-to-ship weapon. It resembles a small aircraft, of some 15ft span, with slightly swept wings of about 12 per cent thickness/chord ratio. The main construction is in flush-riveted stressed skin of less than 20-gauge, although the wing-tips were of solid wood. The only controls appeared to be a conventional rudder and a pair of venetian-blind air brakes which could be run down electrically beneath the inner wings, their position at 90 deg to the airstream being maintained by roller guides. No engine was fitted, and the only external control or sensing device was the long nose pitot. We learnt that the design Mach number was 0.75, and that the design has—as might be expected—long since been superseded.



This is the Curtiss-Wright-Dehmel Type 501 instrument flight trainer. In the foreground is the instructor's occasional seat, and the panel by which he introduces "difficulties."

Montupet.—A variety of aluminium- and magnesium-base sand castings was shown by this famous foundry. The most interesting was a piece of pre-fabricated wing built to the specifications of O.N.E.R.A. (which see) with six pierced ribs and a plate spar. Shown just as it left the mould, without more than a brushing clean, this appeared to have a finish rather inferior to that of similar developments in the U.S.A. and this country.

O.N.E.R.A.—The Office Nationale d'Etudes et de Recherches Aéronautiques corresponds very roughly to our Royal Aircraft Establishment, with a possible leaning towards the theoretical, as distinct from the operational, aspect. This was a stand of singular interest.

The largest exhibit was an excellent one-eighth scale model of the working section of the large transonic tunnel at Modane. The full-size tunnel, which is rapidly nearing completion, has a diameter at this point of 8m (about 25ft) and a maximum horse-power of 110,000. Within the model was a test body, with missile-like profile, mounted on a rather complex wire system.

A novel development was a means for studying the flow of fluids in rocket motors. Two sheets of Plexiglas are placed about one half-inch apart, their profiles being shaped to represent the combustion chamber and venturi of a rocket. Fuel and air is fed into the chamber and burnt, the feed and ignition being initiated very violently. After from one to three seconds the Plexiglas is too badly burnt for the results to be representative, but the initial combustion is photographically recorded at from 1,000 to 3,150 frames/second by a special camera, whose maximum "speed" we were assured was 6,000 frames/sec. By this means can flow patterns be determined to a high degree of accuracy.

A related exhibit was a means for determining the flame temperature of rockets. A photocell, placed near the rocket exhaust, receives in quick succession the emission from a standard reference lamp; the same light after passage through the flame of the rocket; and the light from the rocket alone. Each set of readings is taken at a single monochrome wavelength in the band 4,000 to 8,000 A.U.; and the resulting photocell readings can be made with a frequency as high as 4,500 per second.

A single-stage supersonic compressor rotor was a "monobloc" prototype machined from solid light alloy (R.R.58) to a high degree of precision. The blades were of about 7 per cent thickness, flat on one side with a double wedge profile, the maximum thickness occurring at about 40 per cent chord. The maximum operating speed for this unit—of some 20in diameter—was 28,000 r.p.m.

O.N.E.R.A. have developed a new refractory alloy, which they call Oneral. This has a density of 8 gm/c.c. (S.G. = 8), and a number of test blades were shown after immersion in acid at from 1,000 to 1,100 deg C. For comparison a number of blades of Nimonic 80A were shown alongside, although resistance to acids is not normally a requirement for such blading.

Plessey.—This well-known British firm shared a stand with Thermal Control, Ltd. The most discussed exhibit was the liquid-fuel turbine starter, of the type shown at the last S.B.A.C. show. Since then, the starter has been improved and made more compact, and a licence for its production has been obtained by the Hamilton Standard division of the United Aircraft Corporation in the U.S.A. The Plessey company claim that a start with the liquid-fuel unit costs roughly one-twentieth as much as does the expenditure of a large cartridge of the size needed by the largest turbojets. Altogether, it is difficult to find any reasons for not using liquid-fuel units, although AiResearch remain unconvinced.

Phillips and Pain.—Yet another licensee of British equipment—in this case, Graviner—Phillips and Pain make fire and smoke detection devices, and all kinds of airborne extinguishing systems. Methyl Bromide appeared to be the favoured extinguishing medium.

Rochar.—The main item was a complex electronic equipment for measuring frequencies, such as the r.p.m. of an engine on a test-bed. Various sensing heads record the r.p.m., fuel- and air-consumption, and other parameters, and passes these results to a frequency-meter receiver. The final figures can be obtained precisely by a row of illuminated

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lights, one light appearing in each column of "units," "tens," "hundreds," and so on.

Sadir Carpenter.—Under Ferranti licence this firm makes the R.A.F. gyro gunsight, principally for the Vampire and Mistral. A later version, equipped with a radar-ranging device developed by Sadir Carpenter, is to be standard on the Mystère. Like many other companies, Sadir have developed an I.C.A.O.-standard V.O.R. system, and the ground station was shown as a model; the operating frequency was the usual 108-112 mc.

Sciaky.—The Paris office of this firm of welding-machine makers showed two large items, one a seam welder and the other for high-pressure spot welding.

Both were 3-phase machines, the seam welder being a 150 kVA specimen (400 max.), the short-circuit current being 80,000 amperes. The electrode pressure—on standard copper discs—was given as 4,400 lb. Examples of Sciaky production welding were provided by the Fokker company, who showed a Meteor 8 fuselage tank, and Dassault, who use Sciaky welding around the tip tanks of the Ouragan and Mystère. Other applications were the flame tubes of the Atar and Hispano Nene.

S.E.C.A.N.—Light-alloy welded pressings—no doubt joined by Sciaky—included an Ouragan tip tank, while a complex job in steel, stabilized at 800 deg C, was the "bullet" fairing cone for the jet-pipe of an early Atar.

An unusual light-alloy sheet assembly was the blade for a "centrifugal-induced flow" windmill, and a box in one corner of the stand housed ten complete Mystere underwing tanks, stacked in nesting halves, which can be assembled in the field. S.E.C.A.N. hold world rights to the Lockheed "Speedpak" and the first of 12 for Air France has now been made.

S.F.E.N.A.—A novel exhibit was a model missile, which, mounted vertically on its tail, was designed to be stabilized by two photocells mounted along two axes round its nose. The idea was that, if the missile fell to one side, it cut the light to one cell which promptly moved the tail of the model in the same direction—but it failed to work.

S.N.C.A.N.—In addition to their models of complete aircraft, the Nord group of the Nationalized industry showed a number of plastic parts, such as are fitted to the Nord 2501 transport. In particular, there were polyester-resin access doors, junction box and radio-compass dome, and phenol-cellulose doors and panels.

Sopos.—A wide variety of military aircrew helmets was on this stand, including some hard helmets which appeared to be an improvement on the classic U.S.A.F. P.1 or Lombard. Worn over a thin cloth skull cap, with flat headphones, these crash helmets were of a fibreglass-type substance, and one could jump on them safely. Another range of helmets had a similar foundation, but a leather finish and, if required, could incorporate telephone ear-pieces, which could be accurately adjusted to the wearer's head to cut out extraneous noise. All helmets utilized a carbon microphone mounted on a cantilever boom, of the type long standardized by the U.S. Navy.

AUTOMATIC SEAT-BELT RELEASE

A YEAR ago (*Flight*, June 27th, 1952) we described a device patented by Mr. J. R. Sturge Whiting, of 7a West Street, Reading, Berks, for providing automatic release of a passenger-seat lap-strap after the initial impact resulting from a crash, so that the passenger could be quickly got out by rescuers, or, even if only partially conscious, could make his escape without being troubled to release the belt fastening. The invention, we have since learned, aroused considerable interest among operators both here and abroad.

Now Mr. Sturge Whiting has produced another fitting (likewise the subject of a patent application), this time designed to release automatically the belt fitted to a rearward-facing seat. It is shown in the accompanying drawing, which is intended to illustrate the general principle rather than to detail the exact construction that would be dictated by development considerations.

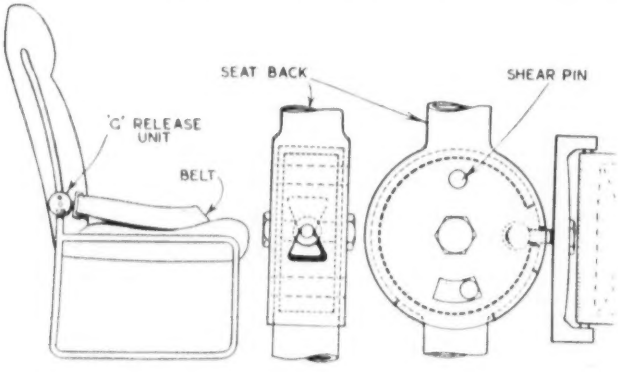
Each side of the seat-back is hinged by a small fitting consisting of an inner barrel welded to the lower section of the tubular structure and, rotatable over a short travel about it, an outer barrel welded to the upper section. Normally, a rigid assembly is maintained by a suitably stressed shear-pin passing through both barrels. In the event of an accident imposing a heavy g-load on the seat-back the pin will shear, allowing the seat-back to tilt an inch or so backwards (i.e. in the direction of flight, since the seat is rearward-facing). A stop-pin in a suitably shaped slot limits the movement to the small travel necessary to effect the next phase of operation.

This second phase depends on the fact that the belt anchorage at each end is by a ball-ended member which passes through a pair of triangular slots cut in the two barrels, and normally retained by the apexes of the slots, as shown in the illustration. When the pin shears, and the outer barrel moves, the two slots come into full register, and the ball-end is thereby freed, so that the belt is immediately released.

We have raised with the inventor the question of safety during any violent movements of the aircraft which might occur (e.g. after a belly landing or a "glancing" crash) subsequent to the initial impact. His argument on this aspect is: "After the first shock of a crash in which there may be more than one impact (by no means typical), the safety-belt has no further duty to perform and has instantly become a danger to the passenger. With a backward-facing seat the only factor calling for belt support after impact would be renewed acceleration during the split seconds between the first and subsequent shocks, and this could take place only if the machine again became airborne *under power* long enough to bring the passenger forward from his position pressed against the seat-back—an impossible hypothesis in the infinitesimal time available."

Mr. Sturge Whiting adds that, following American comments on his original belt-release device, the new project is also intended to be used, if required, on forward-facing seats and in conjunction with that invention. This, he says, would afford "a release action in all directions of g-load except the directly lateral, which would be a most rare occurrence in a forward-moving vehicle out of control."

General arrangement and details of the seat-belt release described above.



SOME RUSSIAN HISTORY

(*concluded from page 80*)

afterwards in his little book *The Rocket into Interplanetary Space* without even having heard of Ziolkovski!

Chapter nine, the last, is headed, "Jukovski and Soviet Science." This claims that many of Jukovski's theories have been wholly or "in part plagiarised" by foreign scientists. Jukovski, it is claimed, "had pointed out that a helicopter rotor had both crosswise and lengthwise forces and movements and gave formula for calculating these." These early works of Jukovski were developed by "Glauert in 1926" and "Locke in 1928," with the result that "abroad many aerodynamic engineers now ascribe theories of the helicopter rotor to Glauert and Locke."

Whilst "highly prizing the work of the world's great discoverers Galileo, Copernica and Darwin, it is the duty of all Soviet scientists, as they study the classical heritage of the past, to strengthen the authority and the individuality of the science of the Socialist Soviet Fatherland."

Commenting on the war, the book states: "During the war the aircraft of Stalin's Air Force were faster and more manoeuvrable and had much heavier and more reliable armament in comparison with the aircraft of the enemy in the West and Far East." "This superiority was due to the sound foundation laid by Jukovski and the high quality of the ensuing scientific discoveries."

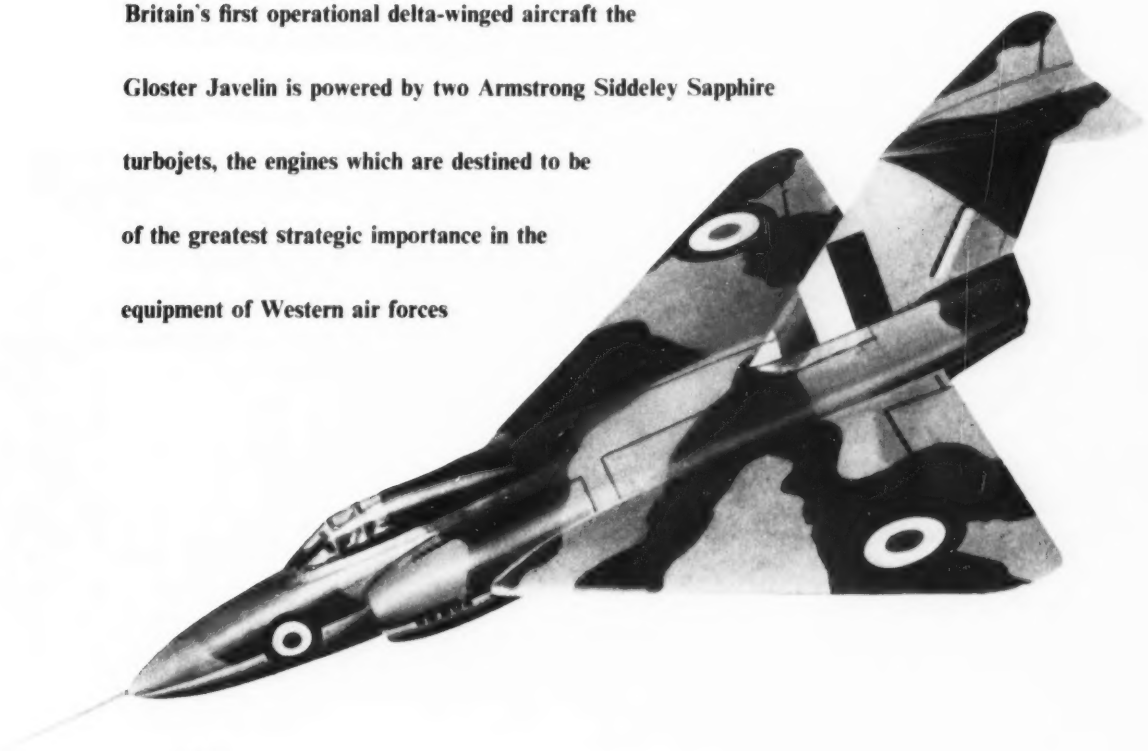
The upper crust of contemporary Russian aircraft designers are given as "Ilyushin, Mikoyan, Lavochkin, Yakolev, Kleenov and Schetzvov." "These and other followers of Jukovski create new types of fast jets which carry on their wings the undying glory to the father of Russian aviation, Professor N. Jukovski."

Owing to the Russian method of phrasing sentences, it is difficult to comment on the general style of the book. Much of it reads smoothly, but occasionally the clumsy wording spoils the rhythm. The paragraphs dealing with the various claims of Russian "firsts" in aeronautics lack the spontaneity of much of the rest of the book and one suspects that these have been carefully vetted and re-written by a higher authority than the author.

A feature boring to the Western reader is the continued repetition of idolatrous phrases. One cannot imagine French or British National Servicemen settling down and reading a book of this nature. But perhaps this is just one of the many things contributing to the great Russian enigma.

Javelin
twin Sapphire fighter

Britain's first operational delta-winged aircraft the Gloster Javelin is powered by two Armstrong Siddeley Sapphire turbojets, the engines which are destined to be of the greatest strategic importance in the equipment of Western air forces



ARMSTRONG SIDDELEY

Sapphire TURBOJET

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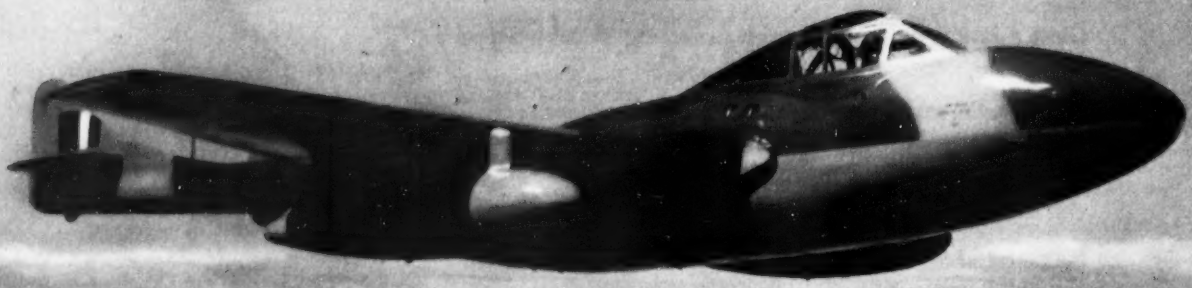
Chosen by the Royal Iraqi Air Force and the air forces of eleven other countries



The side-by-side seating facilitates instruction in

high-altitude combat and gunnery

ground attack with rockets and bombs

high-speed navigation

and handling experience at high Mach numbers

DE HAVILLAND VAMPIRE TRAINER

(de Havilland Goblin jet engine)

DH AIRCRAFT

DH ENGINES

"V" of No. 85 Squadron—a late-production S.E.5A with Wolseley Viper engine and strengthened undercarriage.

THE S.E.5

Historic Military Aircraft : No. 5

By J. M. BRUCE, M.A.

THIS, J. M. Bruce's fifth contribution in his series dealing with famous military aircraft of earlier days, describes the ancestry, development and achievements of one of the greatest fighting aircraft of all time—the Farnborough-designed S.E.5. Former articles in the series appeared on October 17th last (D.H.4), November 7th (Bristol Fighter), December 12th (F.E.2) and February 27th (Handley Page 0/100 and 0/400).

THE S.E.5 was by far the most successful of all the aeroplanes designed at the Royal Aircraft Factory. Its name, and those of the Bristol Fighter and Sopwith Camel, probably symbolize the first war in the air to more people than any other group of contemporary machines. In the hands of such pilots as Mannock, Bishop, Ball, McCudden, McElroy and Rhys-Davids, the S.E. proved itself to be one of the most effective single-seat fighters ever built.

The S.E.1 was not a true ancestor of the S.E.5 but deserves a place in history as the first machine to be designed and built at His Majesty's Balloon Factory, Farnborough. No official encouragement to design and construct aeroplanes was given to the staff of the factory up to the end of 1910, despite their keen desire to do so, but in December of that year an opportunity presented itself in the shape of a Blériot monoplane which had been sent to Farnborough from Lark Hill for repair. This machine had a 60 h.p. E.N.V. engine, and was regarded as so dangerous to fly that it had earned the nickname of *The Mankiller*.

When authority for the repair of the Blériot was sought from the Master General of Ordnance it was requested that the authorization should cover reconstruction. This authorization was granted in January, 1911, and reconstruction began under the general direction of Mr. Mervyn O'Gorman : the design work was carried out by F. M. Green and Geoffrey de Havilland.

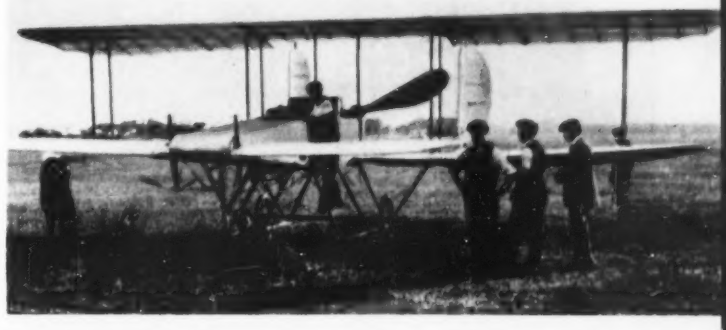
The aeroplane which emerged bore no resemblance to the original Blériot; indeed, the only feature common to both machines was the E.N.V. engine. The product of the reconstruction was a remarkable canard biplane, which was designated the Santos Experimental No. 1, after Santos Dumont, who was regarded as having originated the tail-first arrangement with his 14bis : the Wright brothers were apparently unrecognized. The S.E.1 was the only Santos Experimental to be built. It crashed on August 18th, 1911, killing Lt. Theodore J. Ridge, then assistant superintendent of the factory.

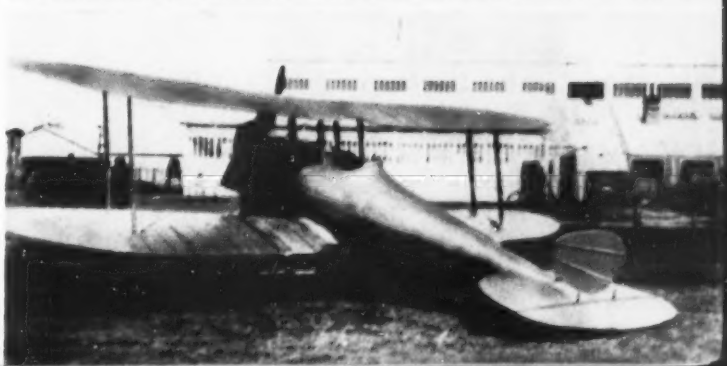
The true progenitor of the later S.E. line was a tractor biplane of remarkably clean lines, known as the B.S.1, or Blériot Scout. This designation, like that of B.E., signified that the aeroplane was of tractor layout, the origination of which was attributed to Louis Blériot. The B.S.1 was mainly designed by Geoffrey de Havilland, and was flying early in 1913. It was the first aeroplane in the world to be built to what later came to be known as the single-seat scout formula. The B.S.1 was first designed to have the 140 h.p. 14-cylinder two-row Gnôme rotary, but the 100 h.p. Gnôme of similar configuration was actually fitted. The tail unit was similar to that of the B.E.3, but the rudder proved to be too small to balance the side area of the deep forward fuselage : there was no fin. The bad directional control led Geoffrey de Havilland to design a new rudder, but he continued to fly the B.S.1 with its original rudder while the new one was being made.

This proved to be the machine's undoing, for it crashed in March 1913, just after having been timed at a mean velocity of 91.4 m.p.h. over a measured course with Lt. de Havilland (as Sir Geoffrey then was) at the controls.

The B.S.1 was rebuilt and re-designated B.S.2, in which form the machine had a considerably larger rudder of higher aspect ratio, with a small area of fixed fin above and below the fuselage, whilst a divided elevator replaced the one-piece surface of the B.S.1. The B.S.2 was powered by an 80 h.p. Gnôme nine-cylinder rotary engine.

Before long the designation B.S.2 was dropped in favour of S.E.2, but now the initials S.E. signified "Scout Experimental," and had no connection with the S.E.1 apart from the preservation of the numerical sequence. The design was further revised, and reappeared as the S.E.2A, still with the 80 h.p. Gnôme, but with





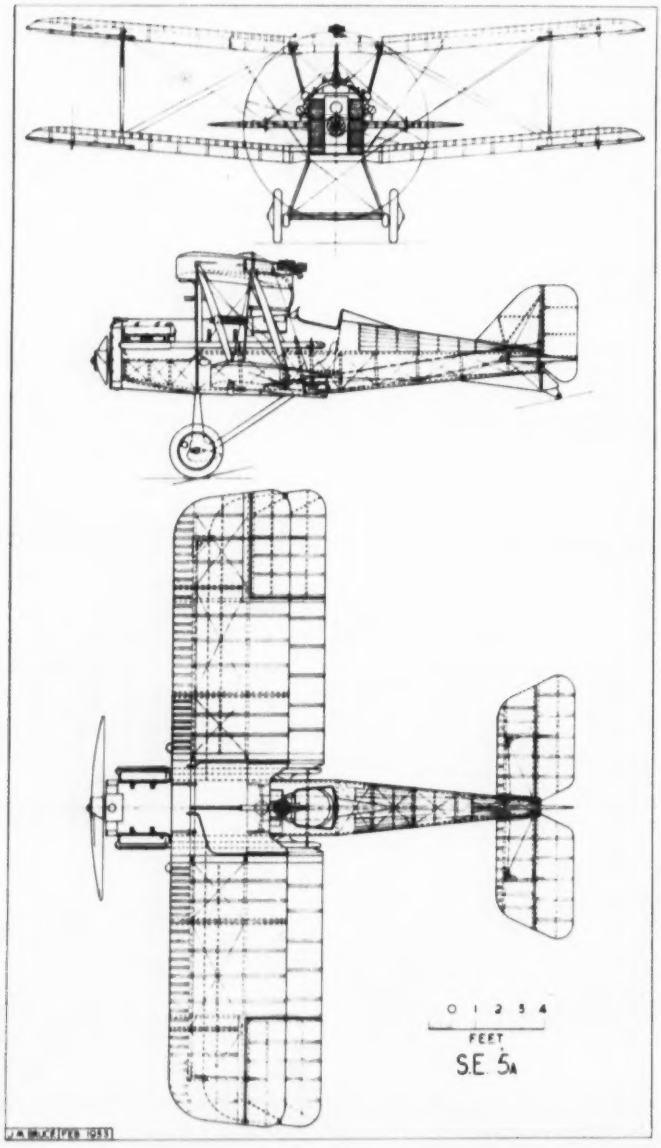
The S.E.1 (upper picture) and the B.S.1.

THE S.E.5 . . .

a completely redesigned rear fuselage and tail unit. The fin and rudder were considerably enlarged, and the rear portion of the fuselage was fabric-covered in place of the monocoque structure used on the B.S.1 and B.S.2/S.E.2. It was the S.E.2A which saw operational service in France with No. 3 Sqn., R.F.C., from October 1914, until March 1915, and of it was said : "Its speed enabled it to circle round the enemy's machines and gave it a decided ascendancy." A further development was projected as the S.E.3, but seems not to have been built.

The S.E.4 was perhaps the most revolutionary of all the S.E. series. It bore a family resemblance to the S.E.2 and S.E.2A, but much of the design was the work of Mr. H. P. Folland, and the whole aeroplane was remarkably clean for its day. The engine fitted to the S.E.4 was the 160 h.p. 14-cylinder two-row Gnôme, closely cowled and driving a four-bladed airscrew. The large spinner had a fan built in to assist cooling, and full span ailerons-cum-flaps were fitted : all joints between control and fixed surfaces were faired. The original undercarriage consisted of an inverted tripod which had a car spring, with a wheel at each end, mounted on its apex; but the machine rolled too much when taxying and a plain vee-type structure was substituted. A transparent cockpit cover of moulded celluloid was provided, but no pilot could be persuaded to fly the S.E.4 with the cover on : it was considered to be too dangerous. The S.E.4 was the fastest aeroplane in the world at the time of its existence : the top speed was 135 m.p.h. and the initial rate of climb was in the neighbourhood of 1,600ft per minute. Unfortunately, the big Gnôme engine was unreliable, and the 100 h.p. Monosoupape was later tried : with the latter engine the maximum speed was reduced to 92 m.p.h.

The S.E.4 was never used operationally, but from it was developed the S.E.4A. This machine bore little resemblance to the S.E.4, although it had similar full-span control surfaces on the mainplanes which could act as either ailerons or flaps. It may have been designed with more regard to production, for it had a plain fabric-covered fuselage whereas that of the S.E.4 was a plywood monocoque. Four S.E.4As were built in 1915, and the type is of considerable interest because its vertical tail surfaces were very similar to those used on the later S.E.5. The 80 h.p. Gnôme was fitted, the two-bladed airscrew having a large spinner with built-in cooling fan. The spinner was later discarded, and the 80 h.p. Le Rhône was also fitted as an alternative power plant. A weapon of some kind could be carried on special brackets above the upper wing, and fired forward over the airscrew. The S.E.4A was highly manœuvrable, and its tractability was demonstrated frequently and to the full by Frank W. Goodden, that great prewar pilot who became chief test pilot at the factory. It is doubtful whether any S.E.4A saw service in France, but at least one was used on Home Defence duties : in late 1915 it shared Joyce Green Aerodrome with a B.E.2C, as part of the defences of London.



It was not until late in 1916 that the next machine of the S.E. series appeared. Designated S.E.5, this aeroplane was the prototype of the single-seat fighter which proved to be one of the most successful aeroplanes of the First World War, and on which the greatest British fighting pilots scored many of their victories. Those chiefly concerned in the design were H. P. Folland, J. Kenworthy and F. W. Goodden, under the general control of F. M. Green, then chief engineer at the factory, and S. W. Hiscocks, then chief draughtsman. The S.E.5 was designed round the 150 h.p. Hispano-Suiza liquid-cooled vee-eight engine, for at that time no suitable British engine was available. The Hispano-Suiza first appeared in 1915, and the first British order for 50 engines was placed in August of that year on the recommendation of Lt. Col. H. R. M. Brooke-Popham, who had examined one in Paris. First deliveries against this order were not made until August, 1916, and most were diverted to the S.E.5s.

The first prototype, numbered A.4561, made its first flights in December, 1916, and the machine proved to be satisfactory. However, an unsuspected weakness in wing design led to the destruction of the prototype at the end of January 1917, and in the crash Major Frank W. Goodden lost his life. Not only was he a fine pilot, but he had assisted considerably in the design of the S.E.5, and his loss was a severe one. Production was halted while the wing design was modified : stronger lift-bracing was fitted, and the production machines began to appear in March 1917. By the end of that month 16 had been delivered. The wings of some of the earliest production machines (e.g., A.4848, A.4850, A.4853), as issued to No. 56 Squadron, retained the same plan-form as those of the first and second prototypes, but others (A.8904, A.8910, etc.) had the wings with blunter tips and slightly reduced span which became standard on all S.E.5s and 5As.

Structurally there was nothing very unusual about the S.E.5, but it was characterized by excellent detail design. A good deal of the aerodynamic refinement which its predecessors had displayed was sacrificed to achieve serviceability and ease of maintenance, and in service the aeroplane acquired a reputation for great structural strength. The fuselage was a typical box girder of wooden construction, cross-braced for rigidity and fitted with a rounded top-decking : a streamlined headrest was fitted to some machines. The covering was of fabric over most of the structure, but plywood was used about the cockpit and as a reinforcing web on the fuselage sides below the engine-bearers. The wings had spruce spars, but no compression struts were fitted : instead certain ribs were made solid and acted as compression members. The incidence of the tailplane was variable in flight, and a sprung steerable tailskid was fitted.

The early production S.E.5s had an external gravity fuel tank mounted above the centre section, but later machines had the gravity fuel supply carried in a tank shaped to fit the nose portion of the upper centre section. Exhausts varied considerably in design, for it was some time before the long horizontal pipes became more or less standard. The first and second prototypes had short manifolds with a single central outlet; other S.E.5s had L-shaped manifolds with the outlet either at the forward or the rear end of the manifold. Most of the early production machines supplied to No. 56 Squadron seem to have had the L-shaped manifolds with forward outlet.

One of the more remarkable features of the S.E.5 was the arrangement of its armament. At a time when twin fixed belt-fed machine-guns were just beginning to come into fashion, the S.E. struck a different note with its single synchronized Vickers in the fuselage and a Lewis on a Foster mounting, firing forwards over the upper wing. The Foster mounting underwent slight modifications from time to time in service, and on some S.E.5 it was a little higher above the centre-section than on others. At first the Lewis gun fired parallel to the Vickers, but before long the rail of the Foster mounting was raised a little at the rear to provide converging fire. The Lewis could, of course, be pulled down for firing upwards, a com-

bat tactic favoured by Capt. Albert Ball, V.C. Both guns were inclined upwards in relation to the line of flight, the Vickers having the greater angle.

The S.E.5 was one of the first fighting aircraft to be fitted with the Constantinesco synchronizing gear for the Vickers gun. At first this gear was not properly understood and gave a good deal of trouble : many pilots shot their own airscrews off, and others found that their Vickers gun would not fire at all. Once the C.C. gear, as it was called, had outgrown its initial troubles it was very successful, but many German pilots owed their lives to the gear's defection in its early days.

No. 56 Squadron, R.F.C., was the first unit to be equipped with S.E.5s, and received its first machine on March 13th, 1917. By April 5th the squadron's establishment of 12 S.E.s was completed, and it went overseas two days later. The first production S.E.s had a curious transparent hood over the cockpit, which was promptly named "the greenhouse" by the pilots. This canopy was probably developed from experiments which had been carried out on A.4561 with transparent side extensions of its windscreen (by which time the machine had acquired L-shaped exhausts with rear outlet), but, whatever its origin, the cockpit cover was greatly disliked, for it interfered seriously with forward visibility, and constituted a danger in the event of a crash. Major R. G. Blomfield, then C.O. of No. 56 Squadron, was alarmed at this impairment of his pilots' fighting efficiency and promptly grounded the entire unit after its arrival in France until a simpler form of windscreen could be devised and fitted. The resulting small flat Triplex windscreen became standard on S.E.5s.

The squadron's first patrol was made on April 22nd, 1917, when five S.E.5s patrolled the line Lievin-Croisilles. Ball was leading, and attacked an Albatros two-seater which fled, nose down, for the sanctuary of the German lines. The patrol was unable to give chase, for it had been expressly ordered that no S.E.5 was to cross the lines. On the following day the S.E.s were used over the lines for the first time, and Ball opened No. 56's scoring by shooting down a German two-seater near Tilloy and a green Albatros scout over Cambrai. Ball was flying a Nieuport scout when he shot down the two-seater, for he did not at first like the S.E., which was not quite so responsive as the lighter Nieuport. On April 26th, 1917, he had a narrow escape from death in the fighting in which, flying an S.E.5, he scored his 13th and 14th definite victories. He was saved only by the speed and double volume of fire of the S.E., and he thereupon became reconciled to the machine, and used his Nieuport only once again over the lines before his death on May 7th, 1917.

No. 56 Squadron had a brief period on Home Defence duties from June 21st to July 5th, 1917, when it was withdrawn to Bekesbourne as a counter-measure to the German air raids on London. During the period no attacks were made on the capital, and the squadron rejoined the B.E.F. Up to this time, No. 56 was the only squadron equipped with the S.E.5, but during the month of July No. 60 Squadron began to replace its Nieuports with S.E.s. A little earlier, in June, No. 56 received the first of the S.E.5As, and was completely re-equipped with the new type by the end of August, 1917.

The performance of the S.E.5 on active service had been closely watched, and operational requirements soon suggested a number of necessary modifications. A more powerful version of the Hispano-Suiza engine became available : it delivered 200 h.p. and had a reduction gear to drive the airscrew. The first installation of a 200 h.p. geared Hispano-Suiza was made in the second prototype S.E.5. The engine drove a two-bladed airscrew and was fitted with short exhaust manifolds. Photographs of this aeroplane show that it had the original longer-span wings, but disclose no serial number. It seems probable, however, that it would be A.4562, for A.4563 existed with a different installation of the 200-h.p. Hispano-Suiza. This last S.E. had L-shaped exhausts, full-length radiator shutters, and the shorter span wings : the engine drove a four-bladed airscrew. The use of radiator shutters was dictated by the increased altitude at which the S.E. could fly and fight when fitted with the more powerful engine.

Production machines with the 200 h.p. engine were re-designated S.E.5A. The forward portion of the fuselage was slightly deeper than that of the S.E.5, and a streamlined headrest was built integral with the after top-decking. This headrest was frequently removed in service by pilots who wanted the best possible rearwards view. The top of the radiator cowling was semi-circular, its sides were slightly rounded, and fairings were usually fitted to each end of the projecting rocker housings. The long exhaust pipes eventually became standard fittings, but some early S.E.5As had short pipes somewhat similar to those of the Sopwith Dolphin. The shape of the cockpit varied considerably, some machines having slightly bulged sides; and the S.E.5As with geared Hispanos usually had four-bladed airscrews.

Early experiences with the higher-powered Hispano-Suiza engines were not happy, and production failures late in 1917 placed the supply of British aircraft, particularly S.E.5As, in jeopardy. As early as May 7th, 1917, Sir William Weir, then Controller of

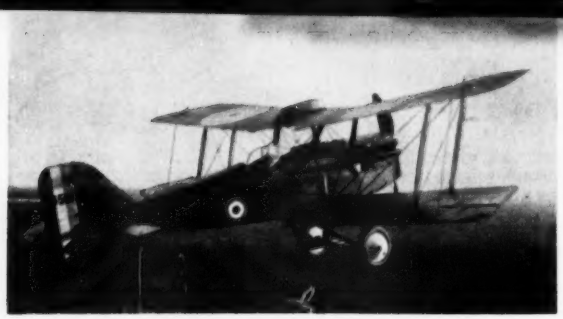
B.S.2 (S.E.2).

S.E.2A.

S.E.4A.

First prototype of the S.E.5.

First prototype S.E.5 (Frank Goodden in cockpit).



First prototype S.E.5 with modified exhausts and windscreen.

Second prototype S.E.5 (200 h.p. Hispano-Suiza).

Second production version with semi-enclosed cockpit and gravity tank.

THE S.E.5 . . .

Aeronautical Supplies, reported that the Wolseley-built 200 h.p. Hispano-Suiza had broken four crankshafts in succession after an average run of four hours each. Trials continued and eleven modifications had to be made, in consequence of which production was considerably delayed. In order to ensure availability of some engines, the Wolseley Company were asked to make 400 Hispano-Suizas of the original 150 h.p. type, but, owing to some misunderstanding, the firm set about the development of a higher-compression engine based on the Hispano-Suiza design. The ultimate product was known as the Wolseley Viper, but by the end of August 1917 only ten had been produced instead of an expected total of 140.

Trouble was also experienced with the 200 h.p. Hispano-Suizas which were built in France by the Brasier concern. Many of them had to be overhauled owing to faulty hardening of the gearwheels and airscrew shaft, but by October 1917 the situation had become so critical that the engines had to be passed for service without overhaul. It was argued that unreliable engines were better than none at all, and entries were made in the engine log-books that the badly hardened gears had been fitted because no others were available. By January 1918, about 400 new S.E.5A airframes were lying in store because there were no engines for them, and probably would have remained there but for the delivery of Mayen-built Hispano-Suizas against an order for 8,000 which had been placed on the insistence of the Admiralty at the end of 1916.

A former member of No. 60 Squadron, writing in 1934, described the situation in the autumn of 1917 in the following terms :—

"We were fitted out with S.E.5s [*sic*], with geared Hispano-Suiza engines, and experienced a devastating period of bad luck with the new machines. Pilots would return from patrol blinded with oil, petrol pipes leaking, 'dud' oil pressure, leaking radiators, choked carburetters, broken gears, half a propeller through faulty C.C. gear, sometimes no propeller at all, due to gears seizing up, fusing and burning the propeller boss, and also due to propeller bosses working loose through faulty grinding of the boss on the shaft.

"This deplorable state of affairs existed for some time, and seriously retarded the work of the Squadron in spite of superhuman efforts to rectify the troubles.

"The sound of the gears, aggravated by faulty carburetters, created a noise that would have discouraged any aspirants for flying honours."

In spite of all these difficulties the S.E.5A proved itself to be a remarkably efficient fighter, as the impressive victory scores of many of the S.E. pilots testify. It would, in fact, be almost invidious to attempt to describe any particular action or actions in which S.E.s participated, but the achievement of Captain W. G. Claxton (37 E.A.) of No. 41 Squadron deserves to be remembered. Flying an S.E.5A on July 4th, 1918, he shot down a Pfalz D.III, an Albatros, two Fokker Dr.1s and two German two-seaters—six victories in one day. (The feat of shooting down six enemy machines in one day was not, of course, unique : on at least two earlier occasions it had been accomplished by Camel pilots, both, as it happened, of No. 43 Squadron. On March 24th, 1918, Capt. J. L. Trollope shot down six, and Capt. H. W. Woollett repeated this performance on April 12th, 1918.)

S.E.5s figured in the combats in which several leading German pilots fought their last fight. Oberleutnant Erich Loewenhardt (56 victories) was killed on August 10th, 1918, as a result of a mid-air collision which occurred in the course of a combat with a large number of S.E.5As over Chaulnes. Leutnant Werner Voss (48) was shot down by Lt. A. P. F. Rhys-Davids (23) on September 23rd, 1917, after fighting with gallant brilliance, single-handed, against six of No. 56 Squadron's best pilots. Leutnant Kurt Wüsthoff (27) was brought down and captured on June 17th, 1918, in the course of a fight between 13 S.E.5As of No. 24 Squadron and 10 Fokker D.VIIs.

On the other hand, S.E.s did not appear in large numbers in the victory logs of the German pilots. Manfred von Richthofen shot down only 3, Loewenhardt 3, Hauptmann Willy Reinhard 1, Wüsthoff 2. Between November, 1917, and September, 1918, the Germans claimed to have brought down a total of 235 S.E.5s within their lines : the comparable figure of Sopwith Camels was 435. The S.E. is, perhaps, epitomised in this sentence from "King of Air Fighters," the biography of Major Edward ("Mick") Mannock, V.C., D.S.O., M.C., written by Sqn. Ldr. Ira Jones, D.S.O., M.C., D.F.C., M.M.: "And as far as my investigations go, it (the S.E.5A) was the most feared and respected of all our war machines by the enemy."

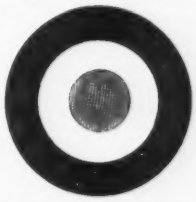
The S.E. had none of the sensitive—almost over-sensitive—

Early-production S.E.5A.

S.E.5A of No. 24 Squadron with reduced dihedral.

ROYAL NAVY

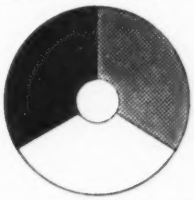
ROYAL AUSTRALIAN NAVY



ROYAL CANADIAN NAVY

IMPERIAL ETHIOPIAN AIR FORCE

ROYAL NETHERLANDS NAVY



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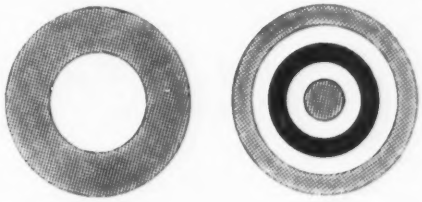
ROYAL DANISH AIR FORCE · ROYAL THAI NAVY



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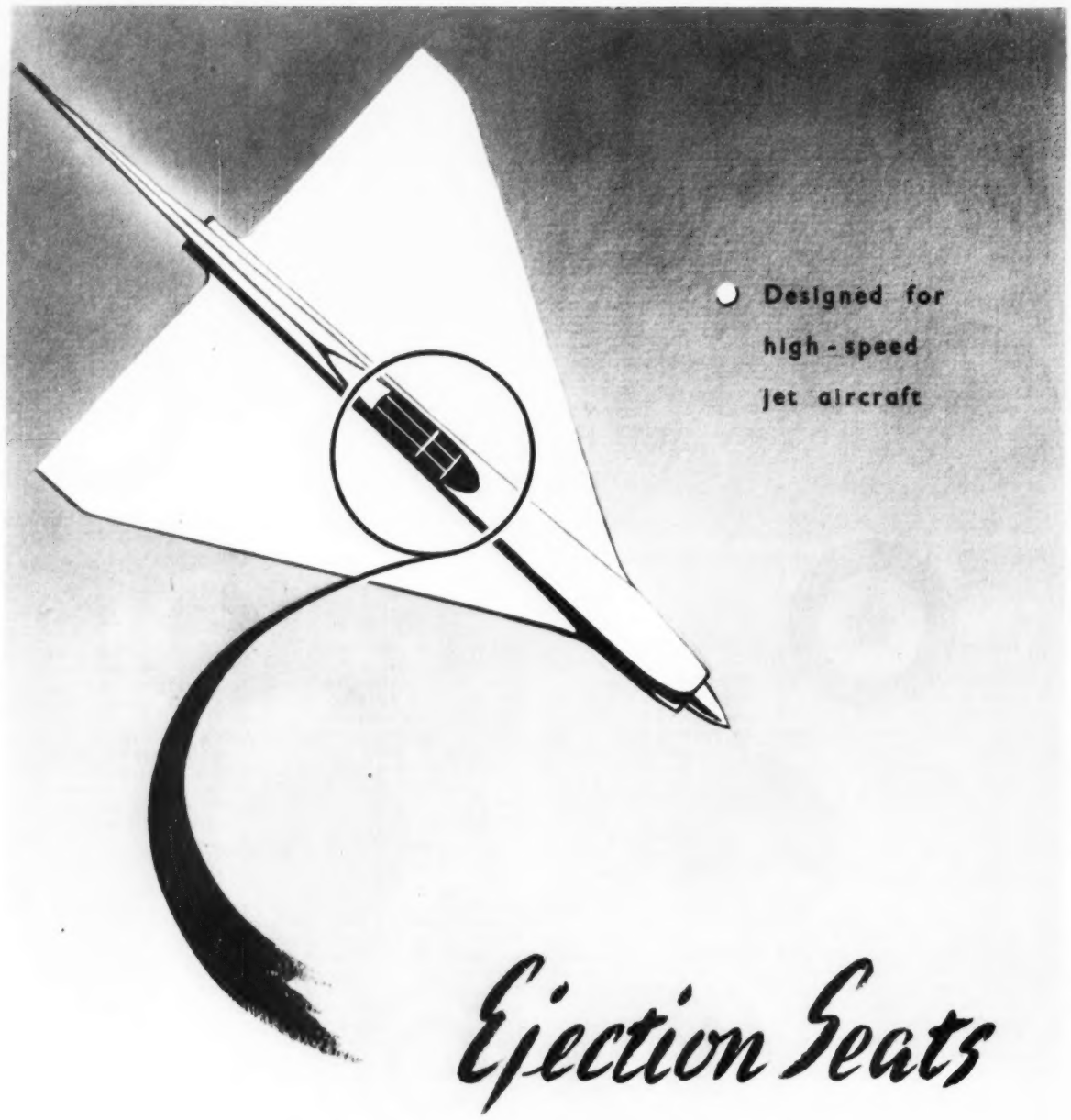

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S.E.5A dual-control conversion.

S.E.5B.

THE S.E.5 . . .

manœuvrability of the Sopwith Camel, but it was stable, warm, and had good climbing characteristics. It was very well liked by those who flew it, for its great strength inspired confidence in combat and its stability made it an excellent gun platform. Some individual modifications were made by those pilots or units who wanted greater tractability. In No. 24 Squadron, for instance, the wings of the S.E.5As were rigged with considerably less than standard dihedral.

Only the sturdy construction of the S.E.5 saved the life of Major G. C. Maxwell, M.C., D.F.C., A.F.C., on April 28th, 1917. Then a lieutenant in No. 56 Squadron, he had fought several Albatros scouts over Fontaine when his S.E. was hit by anti-aircraft fire. The engine and elevator controls were damaged, and Maxwell was compelled to glide down with practically no elevator control over his machine. He struck the shell-pitted ground near Combles at about 140 m.p.h., and the whole front portion of the machine, including the engine, broke off. The rest of the S.E.5, with Maxwell still in the cockpit, bounced along for nearly 100 yards and was completely wrecked. Maxwell was unhurt, and went on to survive the war with a victory score amounting to 27 enemy aircraft.

The whole history of the war in the air from mid-1917 until the Armistice is full of actions fought by S.E.s, and the machine's quality can be assessed from the record of No. 56 Squadron. Between April 23rd and September 30th, 1917, the squadron shot down 200 enemy aircraft; by the Armistice its score had risen to 427. And it is more than coincidence that most of the highest-scoring British fighter pilots flew the type : Mannock (73 E.A.), Bishop (72), McCudden (57) and Beauchamp-Proctor (54) scored many of their victories on the S.E.

McCudden had a specially modified S.E.5A which had a smaller fin and narrow-chord elevators, and was the first machine to be fitted with the stronger undercarriage which later became standard. The machine was numbered A.4891, and carried a red spinner which had been taken from an L.V.G. two-seater shot down by McCudden in November, 1917. The revised undercarriage had strengthened front legs, each of which consisted of an elongated triangle composed of two steel tubes faired over with wood; the original undercarriage, used on S.E.5 and 5A alike, consisted of plain vees of single steel tubes, each leg being of streamline section.

The S.E.5 is always best remembered for its combat exploits, but ground-strafing was also one of the duties discharged by the S.E. squadrons, particularly during the German offensive of March 1918, and the battles of the Lys. A typical record of the use of S.E.A5s in the hazardous work of ground attack is that of No. 24 Squadron. Between February and November of 1918 the S.E.5As of that unit dropped 2,229 twenty-five-pound bombs and fired 92,522 rounds at ground targets.

Development of the Hispano-Suiza engine continued, and its output was raised successively to 220 h.p. and 240 h.p. These engines were fitted to the S.E.5A, but the ultimate production machine had the 200 h.p. Wolseley W.4A Viper, which was a direct-drive engine and maintained its power at altitude more efficiently than the Hispano-Suizas. With the Viper, the S.E.'s speed went up to 135 m.p.h. at sea level, and was no less than 123 m.p.h. at 15,000ft. The Viper-S.E.5A could be distinguished by its deeper radiator, which had a flatter top than that of the Hispano-S.E., and, usually, by the absence of fairings for the valve rocker housings. Some S.E.5As had the Wolseley W.4B Adder, a geared development of the Viper.

The S.E. served in other theatres of war and with Home Defence units, but it was not particularly successful in the latter capacity. It was said to be difficult to land at night on small aerodromes, and its liquid-cooled engine prevented it from warming up quickly and making a speedy take-off such as could be made by rotary-powered machines. Squadrons No. 37, 50, 61 and 143 used the S.E.5A for home defence work, but all had changed over to Sopwith Camels before the Armistice.

In Palestine, the S.E. was used by Squadrons No. 111 and 145. These squadrons effectively kept their opponents grounded from September 19th, 1918, and had a share in the destruction of the retreating Turkish army in the Wadi el Far'a two days later. In the afternoon of September 23rd the S.E.5As of No. 111 Squadron delivered no fewer than 19 attacks against another body of Turkish troops retreating along the Es Salt-Amman road.

In Macedonia, Squadrons No. 17 and 47 each had four S.E.5As by February 1918, and soon made their presence felt in a way which the B.E.12 could never have done when it was the R.F.C.'s best machine in that area. Capt. F. G. Saunders and Lt. G. E. Gibbs of No. 17 Squadron shot down six enemy machines between January 22nd and February 5th, 1918, and on March 13th, Gibbs attacked seven Albatros scouts single-handed, shooting one down into Lake Dojran. These S.E.5As were taken over by No. 150 Squadron on its formation on April 1st, 1918. At the time of the Armistice it had nine S.E.s on its strength.

At home, several experimental versions of the S.E.5A were flown. A two-seat version existed, obviously for instructional purposes : the second cockpit was cut out immediately in front of the normal one, and probably necessitated modification to the main fuel tank which, on the standard S.E., was situated above and behind the engine.

Perhaps the most interesting experimental S.E. was one which was fitted with a balanced rudder somewhat similar to that of the Avro 504, and two small fins on the tailplane. It was used in spinning experiments. Another Hispano-powered S.E.5A was fitted with an underslung radiator, the normal square nose being blanked off.

This last machine may have paved the way for the S.E.5B, a 1918 development which had a streamlined nose with a large spinner on the airscrew and a retractable underslung radiator. The S.E.5B was fitted with sesquiplane wings, and was used in comparative tests with the standard S.E.5A. In order to provide a complete set of comparisons it was later fitted with standard S.E.5A wings. The S.E.5B was numbered A.8947 and survived at least until 1920.

Some S.E.s remained in service after the Armistice until about 1922, but the Sopwith Snipe was adopted as the R.A.F.'s standard single-seat fighter, and the S.E.s were gradually withdrawn. Some were used in further experiments. In 1921 one was fitted with a French fire-prevention apparatus by Major G. H. Norman, who had done a good deal of work on fire-prevention, notably with a specially modified Avro 504K powered by an A.B.C. Wasp engine. Norman was so confident of the effectiveness of the French equipment that he was determined to try it out in the air, and ultimately succeeded in setting fire to the S.E. The extinguisher put the fire out successfully, but Norman was still half-blinded with smoke on the approach, and crashed. He later collapsed and died.

When the British Aviation Mission to the Imperial Japanese Navy went to Japan in 1921, among the sample British aeroplanes it took with it was one Viper-engined S.E.5A. The S.E., together with the Martinsyde F.4, greatly influenced early Japanese design, particularly that of the Mitsubishi S-81.

The S.E.5A was used in the Royal Australian Air Force after the war, and the type was also used in Canada in the post-war years. At least one was used in the Ukraine by the Bolsheviks, and bore insignia consisting of a red star on a white circle which had a thin red outline.

In America, the Curtiss Aeroplane and Motor Corporation was given a contract for 1,000 S.E.5As which were to be fitted with the 180-h.p. Wright-Martin Hispano-Suiza. Only one machine was completed under this contract, but 56 others were assembled from British-made components. On June 30th, 1919, the U.S. Army Air Service had 46 S.E.s in commission and 57 in store : these totals no doubt included the 38 machines which were bought by the American Expeditionary Force in October 1918. In 1922-23, the American firm of Eberhardt assembled 50 machines from spare parts. These machines had plywood-covered fuselages, and were powered by the 180-h.p. Wright-Hispano E; they were given the designation S.E.5E.

A number of S.E.5As came on to the British Civil Register from May 1920 onwards. G-EATE was the first, and it was followed by a batch of eight, G-EAXQ-XX. Not all the civilian S.E.s retained

Viper-S.E.s of "A" Flight, No. 24 Squadron.

S.E.5E.

THE S.E.5 . . .

their original power-plants. The first privately-owned S.E.5A, G-EAZT, belonged to Dr. E. D. Whitehead Reid of Canterbury, and had a 90 h.p. R.A.F.1A, whilst G-EBCA had an 80 h.p. Renault with which the machine's maximum speed was little more than 65 m.p.h.

In the field of civil flying the S.E.5A is probably best remembered for its sky-writing activities in the hands of pilots like Major Jack Savage, inventor of sky-writing, M. L. Bramson, and Sidney St. Barbe. The sky-writing S.E.s had prodigiously long exhaust pipes. The first machines modified for this form of advertising were registered G-EBDS to G-EBDZ, and 'DU gave the first public demonstration on May 30th, 1922. Sky-writing was exploited successfully all over Europe by G-EBFF to 'FI, G-EBGJ to 'GM and G-EBIA to 'IF, and G-EBGJ to 'GL went to America in the service of the Skywriting Corporation of America. There they were modified to have a streamlined nose with underslung radiator and a pointed spinner. The last batch of sky-writers was G-EBQA to 'QC and G-EBVB. Happily, G-EBIC is still in existence, though it is now masquerading under the spurious serial number B.4563—the original B.4563 was a B.E.2E.

All the remaining S.E.5As were privately owned. G-EBOG had a 300-h.p. Hispano-Suiza and was known as the D.W.1 : its owner was the late Dudley Watt. The 120 h.p. Airdisco engine was fitted to G-EBTK and G-EBTO, but all the other civil S.E.s were standard Viper-powered machines.

To attempt to compress the history of one of the greatest aeroplanes of the first World War into the compass of a few pages is an undertaking which can result only in something short of completeness. When the aeroplane is one so richly evocative as the S.E.5, it is inevitable that what is omitted should exceed in volume that which is set down, and the best memories will always be in the minds of those who flew it. In his fine book, *The Clouds Remember*, Oliver Stewart said of the S.E.: "It is of all aeroplanes the richest in the associations of aerial fighting, of hard-contested and long-drawn-out 'dog fights,' of battles against heavy odds, of extraordinary escapes." And so it is, even today, when a few—too few—surviving examples remind us that this aeroplane was real, however legendary its accomplishments and those of the men who flew it may become.

THE ANCESTORS

Dimensions	S.E.1	B.S.1	B.S.2 (S.E.2)	S.E.2A	S.E.4 160 h.p.	S.E.4 100 h.p.	S.E.4A
Span	38ft	27ft 5in	27ft 5in	27ft 5in	27ft 5in	27ft 5in	27ft 5in
Length					21ft		
Height					9ft 10½in	9ft 10½in	
Weight loaded (in lb) ...	1,200	1,230	1,150	1,200			
Max. speed at sea level (m.p.h.)		92	91	96	135	92	

S.E.5 AND S.E.5A DATA

Power Plant.—S.E.5: 150 h.p. Hispano-Suiza (ungeared). S.E.5A: 200 h.p. Hispano-Suiza (geared); 220 h.p. Hispano-Suiza (geared); 240 h.p. Hispano-Suiza (geared); 200 h.p. Wolseley W.4A Viper (ungeared); 200 h.p. Wolseley W.4B Adder (geared). S.E.5B: 200 h.p. Wolseley Viper.

Manufacturers.—The Royal Aircraft Factory, Farnborough, Hants. Known batches of S.E.5As: C.1051-C.1150. D.7001-D.7050.

Other Contractors.—The Austin Motor Co., Longbridge, Birmingham: known batches of S.E.5As: B.8231-B.8346, B.8377-B.8500 (probably parts of a complete batch, which may have been B.8231-B.8500), C.9486-C.9635, D.201-D.300, E.5637-E.5936. The Air Navigation Co., Ltd., Addlestone, Surrey: known batches of S.E.5As: C.1751-C.1950, E.5937-E.6036. Martinsyde, Ltd., Brooklands, Weybridge and Woking: known batches of S.E.5As: B.1-B.200, D.3911-D.4010, E.3154-E.3253, F.5249-F.5348. The Standard Motor Co., Ltd., Coventry. Vickers, Ltd., Vickers House, Broadway, Westminster: known batches of S.E.5As: B.501-B.700, C.5301-C.5450, D.301-D.450, D.3426-D.3575, D.5951-D.6200, D.8431-D.8580, E.1251-E.1400, E.3904-E.4103, F.551-F.615, F.5449-F.5698. Wolseley Motors, Ltd., Adderley Park, Birmingham: known batches of S.E.5As: C.6351-C.6500, D.6851-D.7000, F.851-F.950.

Production.—5,205 S.E.5s and S.E.5As were built; 828 in 1917 and 4,377 in 1918. Of the total, only 238 were built at the Royal Aircraft Factory itself—namely two prototypes in 1916, 132 production machines in 1917, and 104 in 1918. The remainder were built by other contractors.

In America, 57 were built by Curtiss, commencing in August, 1918. Of these, 56 were assembled from British-made components, and one was the first of a contract for 1,000 machines. The signing of the Armistice led to the cancellation of the remaining 999.

Allocation.—To the Expeditionary Force, France, 1,999; to the Middle East Brigade, 172; to Home Defence Units, 74; to Training Units, 728. Distribution of S.E.5s and 5As on October 31st, 1918: With the Expeditionary Force in France, 472; in transit to Eastern stations, 56; Egypt and Palestine, 91; Salonika, 18; Mesopotamia, 13; in transit to and at aeroplane repair depots, 35; squadrons mobilizing, 22; training units, 92; various home establishment stations, 308; with contractors and at aircraft acceptance parks, 182; in store, 1,407. Total number on charge, 2,696.

Costs.—S.E.5A airframe, less guns, instruments and engine, £1,063 10s; 200 h.p. Hispano-Suiza, £1,004; Wolseley Viper, £814; Wolseley Adder, £946.

Armament.—One fixed 0.303in Vickers machine-gun mounted on top of fuselage to port of centre, synchronised by Constantinesco gear to fire forward through the airscrew arc. One 0.303in Lewis machine-gun on Foster mounting above the upper centre-section, fired by Bowden cable. Four hundred rounds for Vickers; four 97-round drums for Lewis. Four 25-lb Cooper bombs could be carried on external racks under the fuselage.

Service Use.—Western Front: S.E.5: R.F.C. Sqns. No. 24, 40, 56, 60. S.E.5A: R.F.C. Sqns. No. 1, 24, 29, 32, 40, 41, 56, 60, 64, 68 (No. 2 Australian F.C.), 74, 84, 85, 92, 94. Home Defence: Sqns. No. 37, 50, 61 and 143. Palestine: Sqns. No. 111 and 145. Mesopotamia: "A" Flight of No. 72 Sqn. Macedonia: Sqns. No. 17, 47 and 150. Operational Training: Schools of Aerial Fighting at Turnberry, Marske, Sedgeford and Freiston.

Known Serial Numbers and Notes on Individual Machines.—S.E.2A: 609. S.E.4: 628. S.E.5: A.4561—first prototype. A.4563—early installation of 200 h.p. Hispano-Suiza; wings of 26ft 7½in span. A.4848, A.4850-A.4856, A.4860-A.4862, to No. 56 Sqn. (A.4850 flown by Ball). A.4891—rebuilt

(*Concluded at foot of page* 93)

DIMENSIONS, WEIGHTS AND PERFORMANCE. S.E.5 AND S.E.5A

	S.E.5 prototypes and early production	S.E.5	S.E.5A 200 h.p. Hispano	S.E.5A Viper	S.E.5A Adder	S.E.5A (American)	S.E.5B
Span	28ft	26ft 7½in	26ft 7½in	26ft 7½in	26ft 7½in	26ft 7½in	{ Upper 30ft 7in { Lower 26ft 6in
Length	21ft 4in	21ft 4in	20ft 11in	20ft 11in	20ft 11in	20ft 10in	
Height	9ft 5in	9ft 5in	9ft 6in	9ft 6in	9ft 6in	9ft 6in	9ft 6in
Chord	5ft	5ft	5ft	5ft	5ft	5ft	{ Upper 6ft { Lower 4ft 3in
Gap	4ft 7in	4ft 7in	4ft 7in	4ft 7in	4ft 7in	4ft 7in	4ft 7in
Stagger	1ft 6in	1ft 6in	1ft 6in	1ft 6in	1ft 6in	1ft 6in	
Dihedral	5 deg	5 deg	5 deg	5 deg	5 deg	5 deg	2 deg 30 min
Incidence	5 deg	5 deg	5 deg	5 deg	5 deg	5 deg	
Span of Tail ...	11ft	11ft	11ft	11ft	11ft	11ft	11ft
Wheel Track ...	5ft	5ft	5ft	5ft	5ft	5ft	5ft
Wing Area (sq ft) ...	249	244	244	244	244	244	278
Weights (lb):—							
Weight empty ...		1,399	1,531				
Military load ...		286	287				
Fuel and Oil ...		245	230	1,940	2,050	2,060	
Weight loaded ...		1,930	2,048				
Max. speed:—							
at s.l.			*	137.8			
at 5,000ft		120					
at 10,000ft ...		116		126			
at 15,000ft ...		105	121	123	116		
Climb to:—							
5,000ft		5 min 35 sec	4 min 30 sec	4 min 55 sec	5 min 25 sec		
10,000ft		13 min 40 sec	10 min 20sec	11 min	13 min 15 sec		
15,000ft		29 min 10 sec	18 min 50sec	19 min 55 sec	27 min 35 sec		
Service Ceiling ...		17,000ft	23,000ft				
Endurance		2½ hr	2 hr	2½ hr			

* 135 m.p.h. with 240 h.p. Hispano-Suiza

Light Alloys and Production Problems

Two Further Papers from the A.F.I.T.A. Congress

SIX papers by British aeronautical engineers were presented at the international congress organized by l'Association Française des Ingénieurs et Techniciens de l'Aéronautique (A.F.I.T.A.) on the occasion of the Paris Aero Show. The contribution by Mr. Petter of Follands was summarized in our issue of July 3rd. We here present slightly condensed versions of two further papers, *High-strength Light Alloys*, by Mr. A. Black of Vickers-Supermarine's research department, and *The Transition from Prototype to Production in Aircraft Manufacture*, by Mr. W. S. Hollyhock of the production department of Hawker Aircraft, Ltd. Of the other three papers, two had already been given in England before the Royal Aeronautical Society, and we hope to give an account of the remaining one, *Some Problems in the Design of High-speed Aircraft and Theoretical Methods of Solution*, by Mr. B. A. Hunn of Hawkers, in a forthcoming issue.

HIGH-STRENGTH LIGHT ALLOYS

The object of Mr. Black's paper was to discuss various limitations and manufacturing difficulties which had arisen in the application of such aluminium alloys to British aircraft construction, and to indicate methods which had proved successful in overcoming these difficulties. The alloys considered were those of specifications D.T.D. 363A and D.T.D. 683. In the introductory tables (I and II, right), the properties of the older alloy, B.S.S. L.65, were included for comparison.

Considered in turn by the lecturer were certain fundamental properties. The first was that of ductility. In common with the majority of metallic alloys, Mr. Black stated, the increased strength of the materials was accompanied by a lowering of ductility as measured by the elongation obtained from a tensile test. A low elongation value was undoubtedly undesirable in an aircraft material, because only small amounts of permanent distortion could take place before a fracture occurred, and large amounts of cold work could not be withstood without fracture.

The specification values for the alloys considered indicated a ratio of proof stress to maximum stress of approximately 85 per cent, but in fact this value commonly exceeded 90 per cent. In these circumstances, the range of stress over which no permanent distortion occurred was greatly increased, and therefore there was a decreased range of strain over which permanent distortion without failure could take place.

The new materials showed large increases in tensile strength, but unfortunately no improvement in fatigue strength. In the stressing of aircraft structures, the fatigue strength of the material used was rarely considered, and it must be assumed that the comparative absence of fatigue failures was due to the factors of safety which were applied to the calculations.

Directional effects were next considered by the lecturer, who said that the ductility of the alloys varied greatly with the direction of grain. The reduced values in the transverse direction might, in fact, be lower than could be considered acceptable for an aircraft structural material, the effect being extremely marked in extrusions and also in large forgings with widely differing sections. A decrease in tensile strength across the grain might also be present, and typical figures for D.T.D. 683 forgings showed well the extent of these directional effects (Table III).

It had been noted that the alloys had a reduced capacity to absorb permanent distortion, a low ductility and a low ratio of fatigue strength to tensile strength. These properties were combined with a high normal stress level in use, and the result was a greatly increased sensitivity to stress concentrations resulting from bad design or surface notches. It was, therefore, essential in design to minimize stress concentration.

Internal stress was produced both by cold bending and by rapid quenching. The magnitude of such stress depended on the relationship between the elastic limit and the maximum stress. If this ratio was high, as was the case with these alloys, residual internal stress would reach a high level, and was very undesirable.

Turning to the question of methods of overcoming manufacturing difficulties, the speaker dealt first with bending and manipulation. Cold bending had for many years been the most convenient method of producing required shapes or of correcting unwanted distortion. The advent of the high-strength alloys had introduced considerable difficulties, and the alteration of established techniques was necessary. In particular, an assessment of the permissible degree of bending was needed.

TABLE I: CHEMICAL COMPOSITION OF ALLOYS

Element	Percentage Composition								
	L.65			D.T.D. 363A			D.T.D. 683		
	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.
Copper	4.8	3.8	4.25	3.0		1.8	1.5		1.3
Magnesium	0.85	0.55	0.6	4.0		2.0	3.5	2.0	2.5
Silicon	0.9	0.6	0.75	0.6			0.5		
Iron	1.0			0.6			0.5		
Manganese	1.2	0.4	0.4	1.0		0.3	4.0	0.25	0.25
Zinc				8.5	4.0	7.0	6.5	4.5	5.75
Titanium	0.3			0.3			0.3		
Chromium				1.0		0.13	0.5		0.13
Aluminium	the remainder								

TABLE II: PHYSICAL PROPERTIES

	L.65	D.T.D. 363A	D.T.D. 683
Properties:—			
Specific gravity	2.79	2.85	2.82
Weight, lb/cu in	0.101	0.103	0.102
Specific heat 0-100 deg C, calories/B	0.21	0.24	0.24
Coefficient of expansion per degree, 20-300 deg C	25×10^{-6}	23×10^{-6}	23×10^{-6}
Thermal conductivity, C.G.S. units	0.27	0.32	0.32
Specific resistance, microhms/cc	4.5	5.0	5.0
Heat treatment:—			
Nominal solution treatment temp., deg. C	505	460	465
Ageing temperature, deg C	170	135	135
Ageing time, hours	10	8	12

Note: The figures given are the normal recommended temperatures for solution treatment and precipitation, and times for precipitation. They may be varied by the material manufacturer or by the aircraft constructor to suit special circumstances

In attempting to assess the permissible amount of bend on a given section, the elastic bending formula had been used by various firms in an attempt to forecast the resulting elongation. The formula was

$$e = \frac{100}{2T+1}$$

where T = the ratio of the radius of bend to the depth of section.

Such a formula did not take into account the angle through which the material was bent, and applied only within the elastic limit. From the results of a small number of tests carried out at the lecturer's firm on the bending of the 8 per cent zinc alloy, it had been possible to evolve a formula giving the relationship between the residual elongation and the various bend factors which arose. This formula was

$$e = \frac{K\theta\sqrt{D}}{2T+1}$$

where e = residual elongation per cent
D = depth of rectangular section
$T = r/D$
r = radius of bend block
θ = angle of bend
K = a constant for the material in a given heat treatment condition.

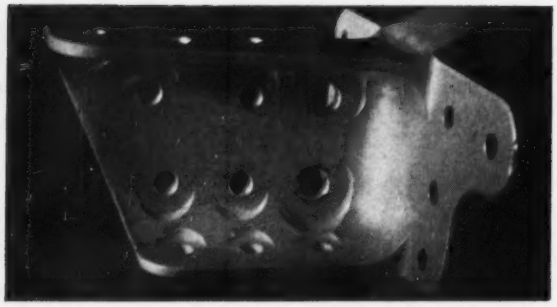
Approximate values for K for the 8 per cent zinc alloy were :— annealed condition, 1.10; freshly quenched, 1.50; fully heat treated, 2.05.

In view of the small number of tests from which this information was obtained, it was put forward simply as a basis on which further tests might be carried out.

It had been seen that the permissible degree of cold bending must be assessed by considering the properties of the material in the plastic range with particular reference to the angle of bend, radius of bend, and size and condition of material. Such cold bending would inevitably result in an internal stress—possibly of an extremely high order—unless subsequent full heat-treatment was carried out. Cold bending was normally carried out by means of hydraulic or fly-presses, using three-point loading. The use of

TABLE III: TRANSVERSE EFFECTS

Property	Specification value	Transverse value
Maximum stress, tons/sq in	32	28
0.1 per cent proof stress, tons/sq in	27	25
Elongation per cent	7.0	2.5



Photographs illustrating Mr. Black's lecture: (Left) The region of any bend should be free from stress-raisers such as notches or holes which will undoubtedly cause premature failures, as in this case. (Right) Cracks such as the one in this machined fitting, found after assembly into the airframe, are caused by bolting or riveting the parts to badly fitting mating surfaces.

LIGHT ALLOYS AND PRODUCTION PROBLEMS . . .

stretch-press technique, however, gave some evidence of producing significantly lower residual stresses and was therefore desirable.

The problems which arose in forming the alloys considered were caused not only by their decreased ductility, but also because design requirements now commonly included long members with varying sections, often with sudden changes in section. The bending of extruded sections which were asymmetric, or in which wide limbs must be bent across their width, presented difficulties which could normally be overcome only by reducing the material to the annealed condition. Repeated annealing would be necessary if the bend were severe.

The process of hot bending was next considered. This could be carried out, the lecturer stated, at either the forging temperature (approximately 430 deg C), or at the ageing temperature, when the ductility was approximately equal to that of the annealed material. The advantages of using the forging temperature were that almost any shape could be produced, internal stresses due to bending were absent, and the risk of rupture during bending was eliminated. Subsequent full heat-treatment was necessary, however, with risk of distortion, and special plant was required. If the ageing temperature was used, similar shapes to those made from fully annealed material could be produced, and no further heat-treatment was required, but some residual stress due to bending was present, and again special plant was required.

Present aircraft design-trends indicated that progressively increasing amounts of machining would be required in the future. The actual removal of material presented no real problem. High rates of rough machining could be used, and the production of a good surface finish was rather easier than with the older alloys provided that a correct finishing technique was applied.

The major difficulty which had to be overcome was that of distortion during and after the machining process, if the material was in the fully heat-treated or solution-treated condition. It had been found that, if machining were done in the annealed condition, distortion did not occur. The subsequent heat-treatment introduced quenching stress, however, but this could be minimized by using an appropriate technique.

A further remedy for distortion caused by machining was controlled stretching immediately following solution treatment. Finally, material could be machined in the freshly solution treated condition, and maintained in that condition by refrigerator storage at approximately – 10 deg C.

It was not normally possible to obtain full mechanical properties where large masses of the alloys were quenched from the solution-treatment temperature. There was also the possibility of internal quenching stresses being raised to such a high level that spontaneous cracking might occur during machining. Another difficulty arising during machining was caused by the appreciable volumetric changes which occurred as the result of heat treatment. Unfortunately, these changes could not be forecast accurately.

The number of defects on large bars, forgings and forged blocks was liable to be high, and it was recommended that anodic treatment by the chromic-acid process, followed by a cold wash instead of the normal hot wash, be used at various stages as a method of inspection. Corrosion could be an important problem, and the materials were more prone to corrode in the solution-treated condition than in the final heat-treated state. Concerning surface finish after machining, the use of a polished mirror finish was ideal, and, provided attention had been given to the avoidance of sudden changes of section, the inherent notch-sensitivity had the minimum adverse effect.

Three typical types of failures were then described by the lecturer. Firstly, machined fittings after assembly into the airframe had subsequently been found to be cracked. This was caused by high stresses induced by bolting or riveting the parts to badly fitting mating surfaces. To avoid this type of failure, it was essential that well-fitting mating surfaces be provided, so that no local distortion of the machined parts could take place during assembly.

The second type of failure, which included the large majority of cases, was due to the lack of appreciation of the notch sensitivity of the material. Thirdly, a limited number of fatigue failures had occurred, particularly in such components as hydraulic cylinders. Here, the alternating stress level had been too high for the large number of reversals. The importance of considering in addition the fatigue strength of other components, however, could not be over-emphasized.

Other points made by the speaker were that large grain-size could occur in both extrusions and forgings, due to critical amounts of work during material manufacture (this had the effect of reducing mechanical properties and increasing notch sensitivity); that the surface condition of forgings to be used without machining could give trouble; and that the inherent difficulty of forging the particular materials considered could also give rise to such defects as surface laps and cracks at the flash line.

In conclusion, Mr. Black summarized his main points by saying that the use of the zinc-bearing high-strength light alloys in Britain indicated that they were satisfactory provided that the limiting factors of reduced ductility, small plastic range of stress, decreased fatigue strength/maximum stress ratio, directional variation of mechanical properties, increased notch sensitivity and liability to coarse grain, were taken into consideration.

In the manufacture of aircraft parts from these materials, it was essential to give serious consideration to the limitation of cold bending, the minimizing of distortion in asymmetric machining operations, the production of a high standard of surface finish, the rough machining of large masses before final heat treatment, and the care necessary during assembly to avoid high local stresses due to badly fitting mating surfaces.

PROTOTYPE TO PRODUCTION

THE problem of the evolution of a line of production aircraft from the basic prototype machine was examined by Mr. W. S. Hollyhock, chief production draughtsman in the design department of Hawker Aircraft, in his paper, *The Transition from Prototype to Production in Aircraft Manufacture.*

The prototype design—a single-engined military aircraft would be considered—arose from the need to produce a superior successor to a current type, the speaker began. The basic role of a fighter aircraft was to fight with guns, and therefore the designer would aim at creating a steady gun platform that would carry as much ammunition as far and as fast as possible, together with the best possible climb and aerobatic performance. Even these possibly over-simplified requirements were conflicting, and the final result would always represent a compromise.

If the prototype design was backed by an official contract, certain other Service requirements would be made known at the time, but even the sum total of all these could not possibly represent the final requirements which would be laid down by the time the aircraft was ready to go into quantity production.

It was therefore clear that it was impossible to decide at the time of the construction of the prototype just what the production aircraft would be like, and, consequently, it was equally impossible to tool up for production with any degree of certainty at that date.

As it was of paramount importance to get the prototype into the air at the very earliest date possible, only the absolute minimum of tooling should be undertaken for it, and this would be inadequate for production, for three reasons. Firstly, the tools would not be sufficiently robust or long-lasting, secondly, they would not ensure interchangeability, and thirdly, they would not allow the full utilization of unskilled or semi-skilled labour.

The suggested scheme for the most efficient prototype-to-production process consisted of three stages, those of prototype, pre-production and production respectively.

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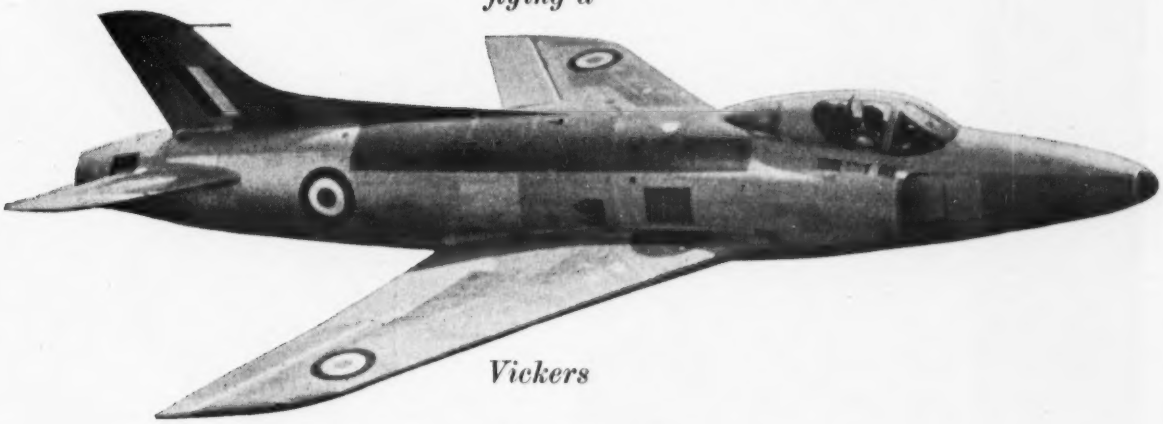

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The prototype was built in the experimental department, which must be under the control of the chief designer. The tooling was of the simplest and most elementary form and the most highly-skilled labour available was used, both for the jools and for the aircraft parts. The erection and flying were carried out under the same control, and the design department was in the closest touch with the experimental department throughout. The drawings would, of course, be of experimental type, and alterations and additions would be carried out in many cases on the spot. When a difficulty arose on the shop floor, the draughtsman concerned could investigate it on the spot, together with the personnel who were actually doing the job, and could often give the answer at once.

It was well known, also, that skilled experimental fitters and their supervisors had many short-cuts and unconventional methods born of long experience that helped to get the job finished satisfactorily and quickly. These were not known to the ordinary production personnel and, even if they were known, they could not be used under production conditions.

Should a moderately extensive alteration become necessary, the inevitable embarrassment was at least minimized by the fact that the tools could be altered comparatively quickly and cheaply. The simple experimental tools used would not be suitable for making more than a few parts, but were quite adequate for one or two prototype aircraft.

Some authorities contended that the experimental department should be dispensed with altogether, and that prototypes should be built in the production shops by production personnel. This suggestion suffered from the following disadvantages: (1) As the number of people engaged on the production was very much greater than was required for even three prototypes, only a comparatively small percentage of the personnel could be satisfactorily employed on the prototypes. (2) The building of prototypes required a particular kind of skill which was not to be found in production shops. The aim in production was to use as much unskilled and semi-skilled labour as possible, and this type of labour was not capable of working without the elaborate tools which were only available long after the prototype was built. (3) Unskilled and semi-skilled workers were in general not greatly interested in the quality of their work. The true experimental worker, on the other hand, was always something of a craftsman.

An even more important aspect of this experimental *versus* production shop argument, however, was the fact that the whole layout and organization of a shop which was building one or two aircraft was vastly different from that where machines were produced on an assembly line basis. This was as it should be, and any attempt to organize prototype construction on production lines would inevitably result in inefficiency and, most important of all, delay in completion.

Concerning the pre-production period, it was assumed that an order had been placed, or was anticipated, for, say, a hundred aircraft, and that it was decided to produce the first ten on a pre-production basis.

One of the first considerations, of course, would be tooling, which must be put in hand without delay. In this connection, serious thought must be given to the question of marrying-up the pre-production and production runs so far as certain major assembly jigs were concerned. By the time the pre-production run was started, the basic design would be sufficiently stabilized to allow quantity production jigs for items such as wing and fuselage structures to be laid down with reasonable certainty that they would not need to be modified later.

If the experimental department had carried out any lofting for the prototype, the loft master-templates could be of considerable assistance to the pre-production department, and it was possible also that use could be made of some of the experimental department's main assembly jigs to start off the pre-production aircraft.

The lesser jigs and tools for pre-production should be cleared on high priority in order that the manufacture of parts might be started. It was to be noted that pre-production tooling differed fundamentally from prototype tooling, in that the question of interchangeability did not arise at all in connection with the latter.

On the pre-production run, it would be necessary to make some parts by special methods. Some or all of the quantity of some forgings would have to be replaced by parts machined from the solid—a wasteful but inevitable process.

At this stage the production specification would have been written and the final requirements regarding equipment and other items made known. Any design changes entailed by this must be introduced as quickly as possible, so that there would be no hold-up in tooling or subsequent delay in delivery due to additions or alterations of detail parts. By the time the last of the pre-production machines was finished, all the more serious problems should be well under control.

The production line was the next phase. The way for this line would have been paved by the pre-production line but, if a break in delivery at the end of the pre-production quantity was to be avoided, the final tooling and manufacture must proceed concurrently with the pre-production tooling and manufacture. The line of main assembly jigs would have been started at the commencement of the pre-production run, but the remainder must be proceeded with urgently.

The lesser items of tools and jigs also must be put in hand when the pre-production tools were started. The same applied to those actual aircraft parts which required specially long fabrication time, such as forgings, die-castings and extrusions. Orders for special materials and bought-out items should be placed at the same time as those for the pre-production aircraft, so that the manufacturers could plan their own output to line-up with the aircraft programme.

Although, as stated, the prototype was designed primarily for performance, it must not be forgotten that its creation was only justified if it resulted in a production order. Therefore, the more amenable it was to "productionizing," the more easily, cheaply and quickly would production aircraft roll off the line. The temptation to introduce unwarranted complexity in the prototype must be resisted at all costs. Otherwise, the production department would be unable to translate the hand-made one-off into large quantities of efficient parts made by operators who, using foolproof jigs and tools, were capable only of repetition work.

Another point was that, although production machinery, equipment and tooling should be efficient, up-to-date and of a standard dictated by the aircraft design—rather than the aircraft being designed down to an existing tooling level—it was useless to design an aircraft which required an unattainable perfection of tooling and manufacture in the full production stage. The chief difficulty in this connection was not the basic conception, but the detail design.

One important side issue was the question of interdepartmental relationships. There were always three opposing forces to contend with, namely, the design department's desire for performance, the customer's desire to fit all the equipment and war-like stores possible, and the production department's desire to deliver as many aircraft as possible in the shortest possible time.

The design department, sometimes perfectionists, demanded a standard of workmanship which was at times beyond the capacity of any production department, as the latter must of necessity use a great percentage of unskilled and semi-skilled labour. It followed, therefore, that the closest possible liaison between the design department and the pre-production department was essential.

The customer's endeavour to carry all the equipment possible was right and proper, but good relations (resulting from close contact at all stages) between him and the design department were necessary if the best compromise was to be attained. Liaison between the production and experimental departments should not be needed, but that between the pre-production and production departments should be of the highest standard. The need for close liaison between design and experimental departments was obvious, and it was for this reason that it had been stated earlier that the experimental department should be under the control of the chief designer.

Changes in policy forced upon Service chiefs by the exigencies of war, or potential war, and changes in equipment were frequent causes of delay in production. The need to keep the aircraft up-to-date made a certain amount of this inevitable, but the manufacturer's design department—usually in the person of the chief designer—should do all that was possible without prejudice to the aircraft's efficiency to limit such changes. Any changes which did become inevitable should be arranged wherever possible to coincide with the commencement or the finish of the pre-production run.

Once full production was under way, new requirements and other changes should be staged to come in at stated intervals, say at multiples of 10 or 20 aircraft. This might not appeal to the customer at the particular time, but it would avoid unnecessary bottlenecks in production and thereby ensure the best possible ultimate delivery programme.

In conclusion, Mr. Hollyhock stated, it was realized that the arrangement suggested was idealistic, having regard to the exigencies of circumstances, local conditions of factory layout, and conflicting commitments of the design department. It was most unlikely that it could be organized to work precisely as set out in the paper. Any scheme, however, must be based on a definite plan if it was to achieve even moderate success, and the particular plan outlined was a logical, balanced and ordered sequence of operations which, if adhered to as closely as circumstances permitted, would bridge the gap between prototype and full production in a satisfactory manner. Furthermore, it would do so with the minimum of upheaval in the various departments concerned, and the minimum financial outlay commensurate with the production of efficient interchangeable aircraft within an acceptable period of time.

THE S.E.5

(*Concluded from page* 90)

specially for McCudden. "6" of No. 56 Sqn. A.8898—to No. 56 Sqn. A.8900, A.8902, A.8903, A.8904, A.8907 (flown by Ball), A.8909 ("AI")—to No. 56 Sqn. A.8934—to No. 56 Sqn. A.8937—to No. 56 Sqn.

S.E.5A: B.1 to B.200 (built by Martinsyde). B.35—to No. 56 Sqn. B.101—"C" Flight, No. 2 Sqn., A.F.C. B.170—to No. 32 Sqn. B.501-B.700 (built by Vickers). B.507—"A" of No. 60 Sqn. B.519—flown by McCudden, No. 56 Sqn. B.525—to No. 56 Sqn. B.530—to No. 60 Sqn. B.533—to No. 60 Sqn. B.574—to No. 74 Sqn. B.4812. B.4897. B.4899. B.7881—"H" of No. 1 Sqn. B.8231-B.8346 (built by Austin). B.8254—"O" of No. 1 Sqn. B.8377-B.8500 (built by Austin). C.1051-C.1150 (built by Royal Aircraft Factory). C.1106—"Y" of No. 1 Sqn. C.1114—"N" of No. 1 Sqn. C.1751-C.1950 (built by Air Navigation Co.). C.1843—"U" of No. 1 Sqn. C.1931—"Y" of No. 85 Sqn. C.6351-C.6500 (built by Wolseley). C.6458—"J" of No. 1 Sqn. C.6468—flown by Mannock, 74 Sqn. C.8740. C.8834. C.8841—"K" of No. 1 Sqn. C.8845. C.8846—"M" of No. 1 Sqn. C.8847—"L" of No. 1 Sqn. C.8904—"A" of No. 29 Sqn. C.9051. C.9081. C.9116. C.9486-C.9635 (built by Austin). C.9539—"C" Flight, No. 2 Sqn., A.F.C. D.201-D.300 (built by Austin). D.276—flown by Mannock. D.353—flown at Australian aerodrome, Minchinhampton. D.301-D.450 (built by Vickers). D.3426-D.3575 (built by Vickers). D.3511—flown by Major Dallas and by McElroy of No. 40 Sqn. D.3911-D.4010 (built by Martinsyde). D.3934—flown at Australian aerodrome, Minchinhampton. D.5951-D.6200 (built by Vickers). D.6851-D.7000 (built by Wolseley). D.6878—to No. 1 Sqn. D.6894—to No. 1 Sqn. D.6998—"C" of "A" Flight, No. 24 Sqn. D.8431-D.8580 (built by Vickers). E.1251-E.1400 (built by Vickers). E.1294—flown by Inglis of No. 85 Sqn. E.1303—"A" of No. 56 Sqn. E.1310—on which McElroy was killed, 31/7/18. E.3154-E.3253 (built by Martinsyde). E.3904-E.4103 (built by Vickers). E.5637-E.5936 (built by Austin). E.5669—"Y" of No. 29 Sqn. E.5937-E.6036 (built by Air Navigation Co.). F.551-F.615 (built by Vickers). F.851-F.950 (built by Wolseley). F.5249-F.5348 (built by Martinsyde). F.5449-F.5698 (built by Vickers). F.5459—"V" of No. 24 Sqn. F.8949. F.8953—"V" of No. 85 Sqn. F.9022. F.9024. F.9029. F.9037. S.E.5B:—A.8947.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

In Perpetuation

THE prototype Comet, G-ALVG, should find an honoured resting place at London Airport, so that passengers in days to come may know that the first jet airliner was British. "Victor George" belongs to the M.o.S., so when its days as an experimental hack are over, please do not let them just throw it away—the fate of so many historic aircraft.

When L.A.P. is completed, let it be named "Alcock and Brown Airport." When a second London airport—at Gatwick or elsewhere—is in being, let it be called "Sopwith Airport," as the now Sir Tommy Sopwith was the first to fly from a point well inland, across the Strait of Dover, to a place well into Europe, when he flew in December, 1910, from Eastchurch to Thirlmont, Belgium —169 miles, winning the de Forest £4,000 prize; this provided the capital on which the Sopwith Company, parent of the Hawker Siddeley Group, was founded.

London, S.W.3. GEOFFREY DORMAN.

Emergency Circuits

THE puzzling feature of the recent Gloster Javelin accident is that of the pilot leaving the aircraft at an altitude of 250ft approximately. According to reports it seems as though he intended making a normal forced landing; it would be logical, therefore, to infer that he intended to stay with the aircraft. In order to make a quick "get away" he would have to jettison the *canopy* prior to landing; I suggest that this was his intention and that leaving the aircraft at that low altitude was inadvertent, for it is obvious that no pilot of any experience would attempt, at that height, to do so voluntarily.

As is known, there are two circuits concerned with the emergency exit: (*a*) jettison canopy only and (*b*) jettison of canopy, ejection seat, etc. If the switch controlling (*b*) circuit is pulled, in error or otherwise, the pilot has no option but to go; this might have been what happened.

I have long held the opinion that such emergency system's could be, with advantage, rearranged. My experience has been that pilots' understanding of these emergency circuits is far from perfect, and it is suggested that revision is a matter of some urgency.

Boscombe, Hants. S. GOULD.

Supersonic Bangs

IN connection with the Cranfield report on supersonic bangs (*Flight*, June 5th, Page 712), I remember reading, I believe about a year ago, that a Sabre destroyed a Mig-15 over North Korea without firing a shot, the Mig breaking up when flying through a shock-wave from the Sabre.

The tail wave at an aerofoil has long puzzled me in that, when returning to subsonic, this shock-wave appears (to me) to give a kind of reverse pressure-flow across the chord; I suppose this type of thing could have had no bearing on the D.H. 110 breaking up over Farnborough—one photo of which, with both engines loose, but with the wing apparently still intact, I still cannot believe.

The ground-attack aircraft seems to have a new weapon in its armoury, in addition to guns, rockets, and bombs (atom, high-explosive, fragmentation, phosphorus, and napalm): it can now use speed alone, to generate a destructive low-level, shock-wave; the ear-plug may soon become as useful as the trenching spade to the infantryman.

Cambridge. PEDANTICA.

FIRST IN THE FIELD: Following his letter published in our issue of June 26th, Mr. G. H. Miles has sent this photograph of the net arrester-gear demonstration carried out at Woodley in 1943. A space 40ft square sufficed for both landings and take-offs, the Messenger being launched with the aid of a rocket-propelled trolley.

Where Helicopters Stop

I MUST apologize for returning to this subject but, whilst Mr. Hall (July 3rd) is to be congratulated on his "H-stop," it seems that I failed to make my point sufficiently clear.

So long as a train runs on rails the name Railway Station is adequate—whatever new form the train may take—and in these days of staggering development in flying machines, who can tell what the future holds? With the advent of the atomic rocket or some other Wellsian contraption lacking rotors, the name Helicopter Station would become redundant. Airway Station would not.

Bridport, Dorset. NORMAN JENKS.

[Another correspondent, "A.V-R." of Rowlands Castle, Hants, suggests in a seven-word letter: "Why not call helicopter landing-sites Aircourts?"—ED.]

Air-display Joy-riding

WHILST attending the Navy Day celebrations at H.M.S. *Gamecock* I, and over 200 others, who had paid and queued for some considerable time for a "joy flight" had to receive our money back because of an order issued by the C.O. grounding the two civil aircraft concerned from 7 p.m.

It would appear that a firm operating from the Skegness area had indeed flown the two aircraft to Bramcote in the morning, had been allowed to do only a few minutes' business, and had then been grounded until after 5.30 p.m. At this time they proceeded to give further flights, subject to interruptions, until about 7 p.m., when they were grounded again, with good flying weather prevailing and about 3½ hours of daylight left.

Perhaps in future, when the taxpayer is invited to one of these "At Homes" the authorities will play the game with civilian aircraft operators, and with the general public, by not advertising and generally giving the impression that joy flights are available to visitors (thousands of them), when in actual fact the "Old Man" intends to curtail pleasure flying to such an extent that only a lucky few can get a flight and the operators run their show at a loss.

Who knows, a chance pleasure flight by the youth of today may well result in another recruit for our air defence—perhaps even a pilot or two for H.M.S. *Gamecock*?

Coventry, Warwickshire. E. G. KENDALL.

IN BRIEF

Mr. C. R. Elliott, c/o 33 Waldingfield Road, Sudbury, Suffolk, is a collector of souvenirs from aircraft that have made history. (His collection includes a relic from the Italian Fiat B.R.20 bomber that crash-landed near Bromeswell, Suffolk, on November 11th, 1940.) He now wishes to acquire "a genuine piece" from Hess's Messerschmitt 110 that crashed in Scotland in 1941.

FORTHCOMING EVENTS

July 18.	"At Home," R.N. Air Station, Brawdy.
July 18.	Royal Netherlands Air Force and Royal Netherlands Aero Club: NATO Display, Soesterberg.
July 18-19.	Aero-Club d'Italia: Dolomites Tour.
July 19.	Aéro-Club de la Vendée: Sables d'Olonne Rally.
July 22.	"At Homes," R.N. Air Stations St. Merryn and Arbroath.
July 25.	"At Homes," R.N. Air Stations Ford and Stretton.
July 25.	R.Ae.C.: National Air Touring Competition.
July 25-Aug. 3.	B.G.A. National Gliding Championships, Great Hucklow.
July 26.	R.A.F. Model Aircraft Association: United Kingdom Championships, St. Athan.
July 26.	International Radio-Controlled Models Society: Aircraft Contests, Southend-on-Sea Airport.
July 27-Aug. 1.	Aéro-Club de France: Parachuting Championships, Blois-Le-Breuil.
Aug. 1.	Opening of Jan Smuts Airport, Johannesburg.
Aug. 1-3.	S.M.A.E.: World Model Championships, Cranfield.
Aug. 8-13.	Round-Switzerland Air Tour.
Aug. 22.	Coventry Air Day and Siddeley Challenge Trophy Race.
Aug. 29.	Vintage Aeroplane Club: Rally, White Waltham.
Aug. 30.	Aero-Club d'Italia: Pescara Rally.
Sept. 3-10.	Aéro-Club de Cannes: Cannes Grand Prix.
Sept. 6.	S.M.A.E.: "Yorkshire Evening News" Model Flying Festival, Sherburn-in-Elmet.
Sept. 7-13.	S.B.A.C.: Farnborough Display and Exhibition.
Sept. 12.	"At Home," R.N. Air Station Eglinton.
Sept. 14.	R.Ae.S. Wilbur Wright Memorial Lecture: "Structures," by Prof. N. J. Hoff, F.R.Ae.S., F.I.Ae.S.
Sept. 14-17.	R.Ae.S. and I.Ae.S.: Anglo-American Aeronautical Conference.
Sept. 15.	Battle of Britain Day.
Sept. 19.	"At Home," R.N. Air Station Abbotsinch.

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R.C.A.F. Photograph

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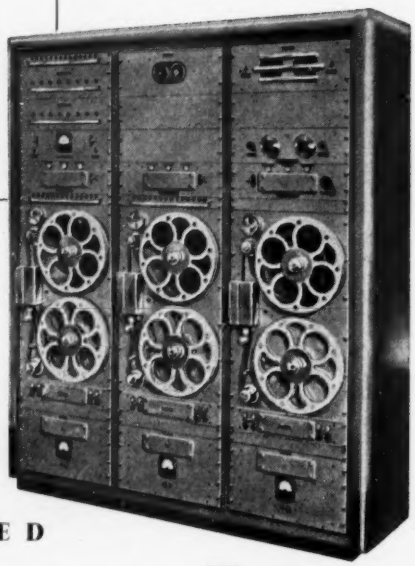

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THE INDUSTRY

English Electric's £6½m Issue

ANOTHER big share issue in the aircraft industry was announced last week. The English Electric Co., Ltd., is to raise some £6,500,000 by the issue of Ordinary shares and debenture stock. The application lists were due to open and close yesterday, July 16th.

The issue has not come as a surprise to the City: the balance-sheet issued last February showed that bank facilities had been called upon to a considerable extent, and by the end of June borrowings had exceeded £12m. The necessity for the extra capital is dictated by the steadily increasing business of the group, both in the field of defence work and in production of general industrial and domestic equipment.

Lodge Plugs Appointment

THE appointment of Mr. V. Martin-Jones as managing director of Lodge Plugs, Ltd., is announced. Joining the company in 1938, from Armstrong Siddeley Motors, where he had been for 13 years, Mr. V. Martin-Jones was made responsible for Lodge technical sales. He was appointed to the Board as executive director as recently as November 1952, and his new appointment takes effect from June 23rd.

He is 43 years of age, was educated at Wellingborough School, Northants, and lives at Dunchurch, Warwickshire.

A New Sealant

FROM Cellon, Ltd., Kingston-on-Thames, Surrey, comes a note on their new "Celloseel" jointing compound, which has been devised to overcome the problems arising from seepage through airframe joints of both hot kerosine and the highly penetrative ester lubricants.

The new compound conforms to Specification D.T.D.369A and holds approval No. R.D. Mat. 4301 under Spec. D.T.D.900. This approval covers the use of the material as a corrosion-preventive jointing compound for use within joints, rivet holes, etc., and for application by wet assembly methods in construction and repair. It is available in 8 oz. tubes, one-pint tins, or one-gallon containers.

Westland Apprentice Prize-giving

AT the Westland Apprentice Association's annual dinner, held recently, Mr. E. C. Wheeldon (managing director) presented the awards. Among those present were Mr. D. C. Collins (works director), Mr. D. L. Hollis-Williams (technical director), senior executives, and representatives of the apprentices of associated companies.

Both Mr. Wheeldon and Mr. Collins stressed the importance of a high standard of practical and technical training as the only sound foundation upon which the industry could be competently maintained and expanded to meet the increasingly complex requirements of modern aviation developments. There were, and there always would be, many openings for those young men who took full advantage of the opportunities offered by a sound apprenticeship scheme and there were present many who by their successes made it apparent that they were fully aware of this fact.

The Managing Director's Cup for the best apprentice of the year (1952) was awarded to J. W. C. Sandford, who entered his apprenticeship in July 1950. Assessment is based on all aspects of training, both practical and technical, together with sportsmanship, citizenship and Apprentice Association activities. Runners-up were J. S. G. Male, D. N. Redden and A. H. Tucker.

Outward Bound Sea School courses were awarded to Peter Coomer (engineer apprentice) and Anthony J. Hazell (craft apprentice) for showing the greatest improvement and progress in their respective grades during 1952.

Seven Higher National Certificates and 23 Ordinary National Certificates were presented and 95 apprentices received their City and Guilds or National Group Course Certificates.

Mr. S. J. Lobb (apprentice supervisor), reviewing the year's activities, congratulated the Association's executive committee on the hard work done and excellent results achieved.

IN BRIEF

Short Brothers and Harland, Ltd., have recently established an auxiliary planning office at Rochester Airport, Kent, in order to handle certain contract planning work and to procure and progress local sub-contracts for the manufacture of tools.

* * *

Compressors and exhausters, ram pumps, valves, and air-operated starters for petrol or diesel engines are among the products illustrated in literature from Williams and James (Engineers), Ltd., Chequers Bridge, Gloucester.

* * *

A series of twenty filmstrips, covering the two final years in the Ordinary National Certificate course in electrical engineering, has been produced by the technical publications department of Mullard, Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

* * *

Mr. Hugh McC. Jack, B.Sc., relinquished his executive duties as chief electrical engineer of the British Thomson-Houston Co., Ltd., on June 30th, but retains his directorship. He will be succeeded by his chief assistant, Mr. G. S. C. Lucas, O.B.E., M.I.E.E.

* * *

Following the death last February of Mr. J. A. Peters, founder-director of Petbow, Ltd., generating-plant specialists, two new executive appointments have been made. Mr. R. C. Bird, who has been with the company since 1931, becomes managing director and Mr. H. G. Puttick (technical manager for the past two years) is appointed a technical director.

* * *

A new edition of *Notes on Machining the Nimonic Series of Alloys* has been issued, containing additional information on drilling and extended to cover the newer alloys, Nimonic 90 and 95. This publication provides general guidance based on practical experience; suggested speeds and feeds are given for each operation, together with diagrams of profiles and tool forms taken from actual machining operations. Copies are available from the Publications Department, Henry Wiggin and Co., Ltd., Thames House, Millbank, London, S.W.1.

MINERAL SURVEYING FROM THE AIR

IN *Flight* of April 24th we published photographs of a Percival Prince that had been fitted by the Hunting Group with a magnetometer, and certain other equipment, to enable it to be used for making an aerial survey for oil in East Africa. Some further information on the use of airborne magnetometers for locating mineral deposits is now available.

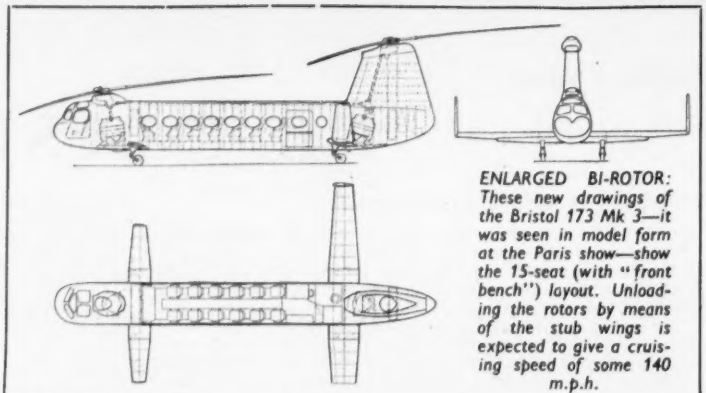
This type of instrument can do one thing, and one thing only. It measures the earth's magnetic field, and records variations in it as the aircraft flies along, normally at a constant height. Thus it can be used directly to locate deposits of magnetic ore. Magnetite is by far the most magnetic of the common ores, and can readily be identified, while pyrrhotite has fairly marked magnetic properties; but it is not possible to differentiate, from the readings alone, between a concentrated pyrrhotite and a dispersed magnetite deposit.

With all other minerals, the information provided by the magnetometer can be used only indirectly. As a general rule, nearly all igneous and metamorphic rocks contain sufficient magnetite impurities to affect the readings, whilst sedimentary formations usually do not. Thus a comparison of the magnetometer chart with a geological map (if available) of all or part of the area will often lead to useful conclusions as to the probable nature of the various strata. At the least, time will be saved by ruling out areas that are out of the question so far as a particular mineral are concerned.

It is clear that the magnetometer method of exploration can also be employed on the ground, and for small, easily accessible areas of complex geology this is probably preferable. For larger areas, however, particularly if they are remote, an excellent case can be made out for aerial survey, which gives a broad picture unadulterated by local effects, and is claimed to be both quicker and cheaper for a given job.

In conclusion, it may be stated that the airborne magnetometer technique has already been used with success in the location of a number of mineral deposits, amongst them petroleum, asbestos, titanium, bauxite (the commercial source of aluminium) and uranium, to name a few that are of particular interest to the aeronautical fraternity. Uranium and similar radio-active deposits, incidentally, can also be sought out by the airborne scintillometer. This device contains a crystal of activated sodium iodide, which has the property of emitting light-flashes when struck by gamma radiation; these flashes can be "counted" by means of a photo-electric cell unit, and thus the intensity of the ground radiation can be determined, and hence the magnitude of the deposit.

CIVIL AVIATION



ENLARGED BI-ROTOR: These new drawings of the Bristol 173 Mk 3—it was seen in model form at the Paris show—show the 15-seat (with "front bench") layout. Unloading the rotors by means of the stub wings is expected to give a cruising speed of some 140 m.p.h.

PARIS MODELS

AMONG the items of civil aviation interest on view on the stands of the Paris show at Le Bourget were the five models pictured below.

The unique power-plant arrangement on the 70-seat S.E.210 Caravelle features two turbojets (Rolls-Royce Avon RA 16s are envisaged), mounted in pods on either side of the rear fuselage. Two Caravelle prototypes are under construction at Toulouse. Smooth and sweeping are the lines of the Agusta AZ.1, a 50-seat transport of more conventional appearance which is to be powered by Bristol Proteus 705 turboprops (with Wright turbo-compounds as an alternative). A prototype is being constructed.

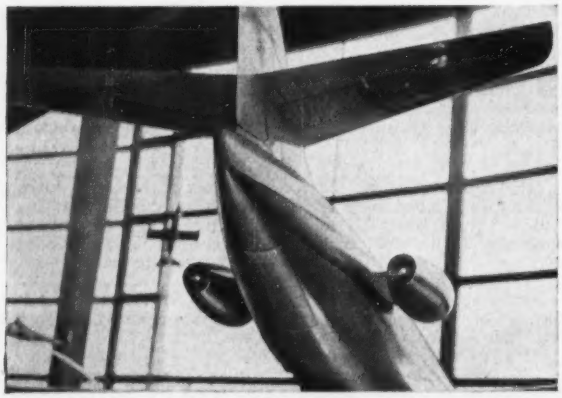
Most advanced of the Hurel-Dubois high-aspect-ratio designs is the projected H.D.45. Carrying between 70 and 80 passengers, the machine has a span of 148ft 8in; aspect ratio is 18.75, gross weight 90,390 lb, and cruising speed 447 m.p.h. Avon 16s are the intended engines. The special version of the Nord 2501 Noratlas fuselage shown accommodates 36 rearward-facing seats and has an observation lounge with large windows at the rear end. Five of the normal versions of the type took part in the flying display at Le Bourget.

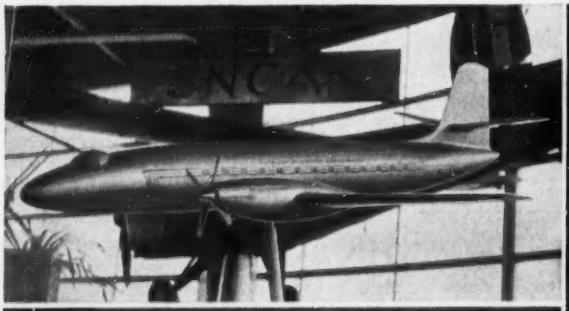
The British exhibit shown is the first model of the enlarged Britannia, the Mk 300. The seating is seen to be that of the standard 104-passenger layout, the alternative being a 60-seat luxury arrangement for long-distance services.

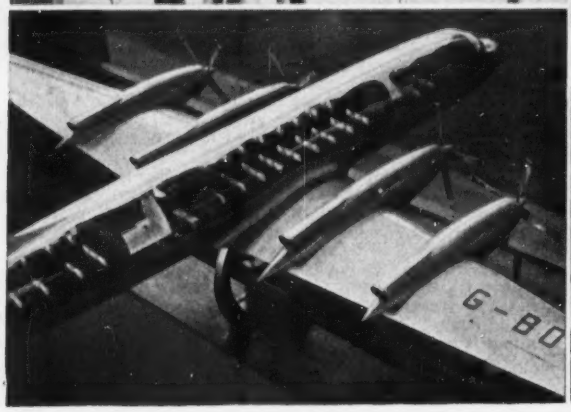
WORLD INDEPENDENTS MEET

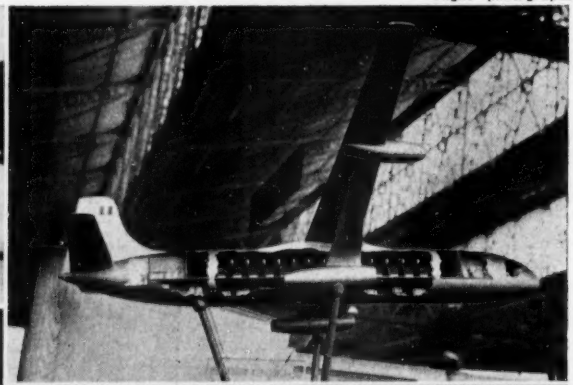
A QUARTERLY meeting of the Federation of Independent Air Transport Operators took place in Paris on June 29th. Present were delegates from Spain, France, Scandinavia, and Great Britain. Concern was expressed over the report by the president, A. Cdre. G. J. Powell (Silver City Airways) that a British independent airline, granted an operating licence by the M.C.A., had been prevented from opening the service because of a ruling by I.A.T.A. that the fares were too low. The route concerned was the proposed Newcastle-Scandinavia service of Hunting Air Transport.

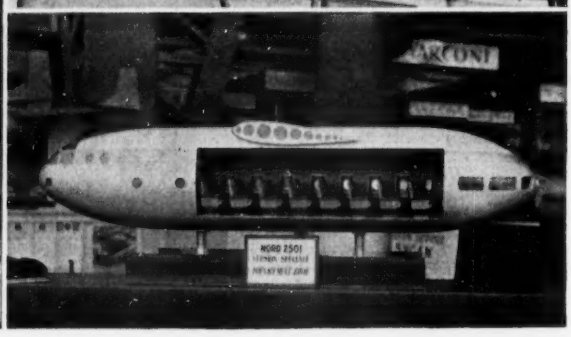
All members reported a substantial growth in private-enterprise air business, but expressed the opinion that fares had now reached





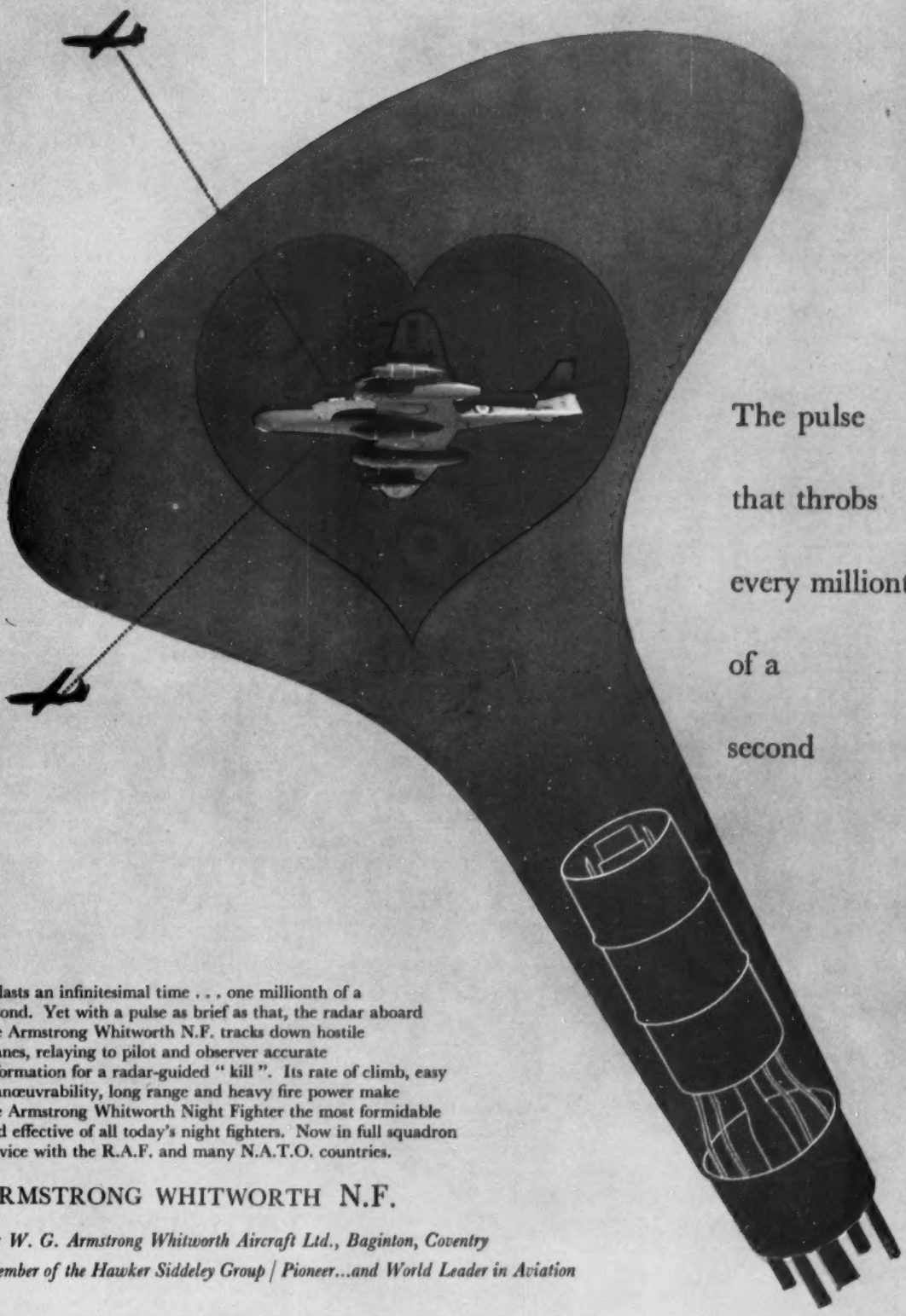






MODELS AT LE BOURGET: (Left) The unconventional engine arrangement of the S.E.210 Caravelle. (Below, upper left) The Proteus-powered Agusta AZ.1. (Lower left) The part-cutaway model of the Britannia 300. (Upper right) Typically Hurel-Dubois: the H.D.45 jet transport. (Lower right) The special "observation car" Noratlas.

"Flight" photographs



The pulse that throbs every millionth of a second

It lasts an infinitesimal time . . . one millionth of a second. Yet with a pulse as brief as that, the radar aboard the Armstrong Whitworth N.F. tracks down hostile planes, relaying to pilot and observer accurate information for a radar-guided " kill ". Its rate of climb, easy manœuvrability, long range and heavy fire power make the Armstrong Whitworth Night Fighter the most formidable and effective of all today's night fighters. Now in full squadron service with the R.A.F. and many N.A.T.O. countries.

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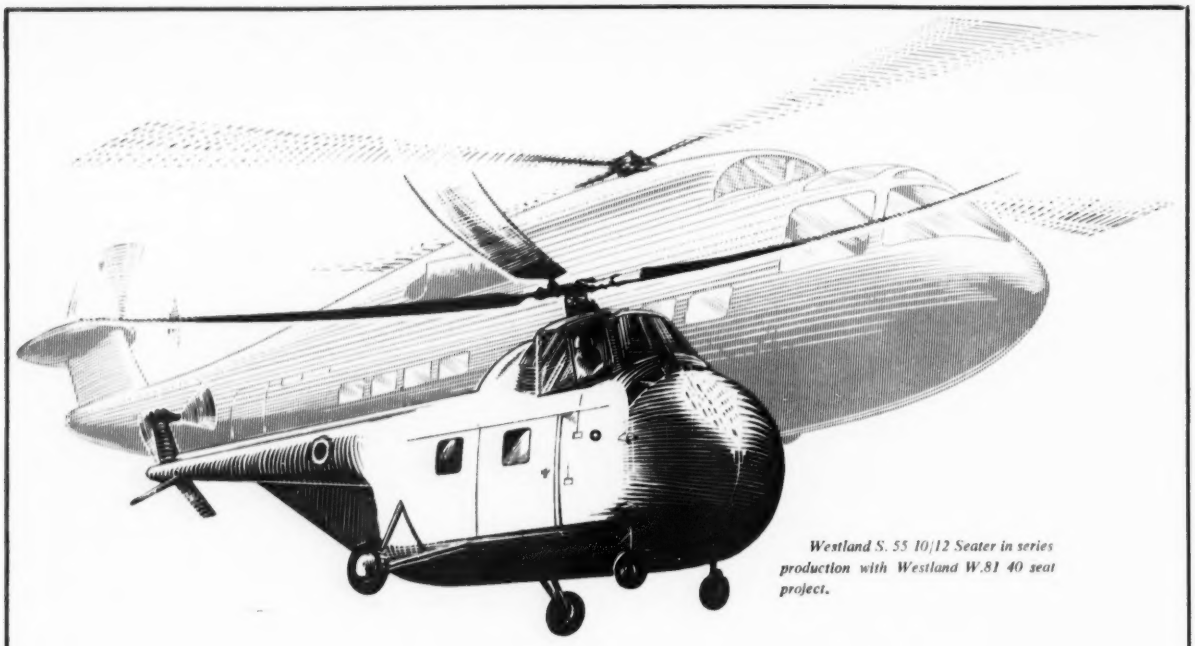

Westland S. 55 10/12 Seater in series production with Westland W.81 40 seat project.

The WORLD'S
GREATEST EXPERIENCE

of rotary wing engineering, design, and over a million flying hours,

IS BUILT INTO EVERY

WESTLAND HELICOPTER

No other British helicopter has anything like as many flying hours to its credit or as many machines in civil and military service throughout the world.

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EUROPE'S LARGEST AND BUSIEST HELICOPTER FACTORY

CIVIL AVIATION . . .

their lowest economical point. After A. Cdre. Powell had mentioned the financial difficulties facing the British companies who wished to purchase new aircraft, both British and French operators reported improved relations with their Governments and Ministries. The value of official consultation was felt to be most useful, particularly in matters of safety.

The next meeting of the Federation, which is its general assembly, is to be held in London on September 10th.

THE I.C.A.O. ASSEMBLY : A SUMMING-UP

ON July 7th the delegates of the 52 contracting States, five non-contracting States and five international organizations which took part in the seventh annual assembly of I.C.A.O. concluded their deliberations. The task of the assembly, held at Brighton, was "to review the work of the Organization in the administrative, economical and technical fields over the past three years, and to provide the 21-member Council and its subsidiary bodies with policy decisions for the future."

Whether or not the world air-transport situation has undergone any radical changes as a result of the assembly is difficult to say. The discussion of problems on so vast a scale seems to hamper rather than foster the production of any policy decisions. The proceedings of I.C.A.O. appear cumbersome and verbose, and the observer may wonder how many—or how few—needles lie hidden in the haystack of words.

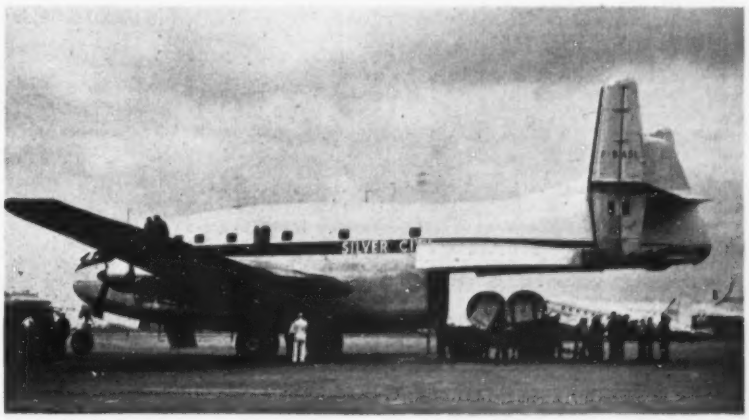
In the post-war years I.C.A.O. has certainly accomplished vital work in laying down the basic code of conduct for international air transport. Considered as an offspring of the United Nations Organization, it has had a far more successful life than its parent body. Today, however, its progress appears to be slowing up; the results achieved by the Brighton assembly seem small in relation to the effort involved. Perhaps time will prove us wrong; but we believe that the nebulous quality of an official summary of the assembly (extracts of which are quoted) bears out this view.

The important question of the exchange of traffic rights "was thoroughly studied and discussed in Brighton. The conclusion reached was that the time was not yet ripe for attempting world-wide agreement concerning the exchange of commercial rights in international air services. It was, however, agreed that the I.C.A.O. Council should study what might be achieved by means of general agreement concerning certain partial solutions, producing results of practical value on the way towards the objective of multilateralism in the exchange of commercial rights.

"The possibility of some form of regional agreement has been raised by the Council of Europe which wishes to see the unification of Europe extended to the air. The Council of Europe have requested I.C.A.O., as the international body concerned with all aviation problems, to convene a conference to consider various measures to co-ordinate and improve European air transport. This proposal has been approved by the I.C.A.O. assembly, and preparations for the conference will shortly be made. The forthcoming European Air Transport Conference will have that type of support at governmental level which is necessary to make progress in cutting away red tape from international travel, in order to set the *bona fide* passenger free to go wherever he wants, without let or hindrance."

Non-scheduled operations were also discussed, the general opinion being that "it was too early to expect universal freedom for this type of transport, but it was agreed that the I.C.A.O. Council should explore this matter to see how charter operations could be distinguished from regular services, and which charter operations could be given general freedom of operation internationally, without encroaching on traffic of the regular services. . . ."

With one exception, the basic "annexes" which lay down international standards, practices and procedures, are said to have reached the stage where stress can be placed on implementing rather than evolving them. The exception is, of course, the case of international standards for airworthiness. The main conclusion reached at Brighton was that "it would be desirable for international airworthiness standards to exist to which all aircraft would have to conform. Such standards would naturally have to be limited to broad principles of safety and airworthiness, for otherwise initiative in the design and performance of aircraft, on which progress depends, would be stifled. The advent of the jet age has emphasized the desirability of some action being taken by I.C.A.O. to develop international airworthiness requirements to which it would be incumbent upon all aircraft-producing States to conform. The I.C.A.O. Assembly in Brighton was of the opinion that it is highly desirable to arrive at a solution at the earliest possible date, and it adopted a resolution which will strengthen the hand of the Council in the task it has already undertaken on this very important question. . . ."



ON TRIAL: Pictured at Templehof is the Breguet Deux Ponts which, as mentioned overleaf, has been leased by Silver City Airways for a period of experimental service on the "minor airlift" between Berlin and Hamburg.

PUBLIC-ENCLOSURE PROGRAMME

PUBLISHED with M.C.A. approval, *The Airport Visitor** is designed to answer the queries of the many people (last year there were 650,000) who watch the comings and goings of airliners from public enclosures. This year's enlarged and fully revised 60-page edition illustrates, describes and lists the main British airports and the types of airliners which use them, and quotes in alphabetical order the registrations of transport aircraft likely to be seen in this country. The Commandant of London Airport, Air Marshal Sir John D'Albiac, contributes the foreword, Mr. Peter Masefield writes on transport helicopters, and "Jerry" Shaw gives a personal account of his historic London-Paris flight; other features include articles on ground aids, a guide to airline operators and Wren drawings.

**Edited by S/L. N. J. Freeman and G. D. H. Linton. Published at 2s by Penman Enterprises, 4d, 202 Cheam Common Road, Worcester Park, Surrey.*

SILVER CITY'S OWN AIRPORT

TUESDAY, July 14th, was the fifth anniversary of the start of Silver City Airways' cross-Channel car ferry. The chairman, A. Cdre. Griffith Powell, chose this appropriate moment to make two important announcements : first, that the company's traffic is expanding beyond all expectations; and second, that to cope with further expansion plans are being made for building a privately-owned airport in the Romney Marsh area of Kent.

Last year Silver City carried some 7 per cent of the 150,000 vehicles which cross the Channel in a year : this year the proportion has increased to over 25 per cent. The number of vehicles carried in 1952 was 11,000 : the 1953 target of 30,000 bookings has already been passed, and the total may reach 45,000. In the first six months of this year 10,138 vehicles were carried. On peak days as many as 600 vehicles and 1,500 passengers are being ferried across the Channel in Silver City's Freighters and Superfreighters. Incidentally, the last of the six new Superfreighters left Filton one recent morning on its delivery flight at 6.30 a.m. and within 1½ hr was carrying cars from Lympne to Le Touquet. The airline has an option on three more Superfreighters, and has transferred some earlier-type Bristol 170s from charter work to carry the increased traffic.

Silver City's proposal to build a new airport to relieve pressure at Lympne is put forward in the following terms :

". . . The position and configuration of Lympne make night flying and instrument weather procedures impossible. However, on the assumption that five or six aircraft operating up to 50 return services a day is a reasonable complement for Lympne, Silver City propose to limit movements to this figure and to put the surplus elsewhere. . .

"Apart from Lympne there is no suitable alternative airport within cheap-fare range of the Continent and Silver City are therefore taking the unique step of building their own ferry terminal. The new airport, which will be situated in the Romney

OO-SHA is the registration given to the first of three Sikorsky S-55 helicopters for Sabena; delivered last week, the machine is pictured at Antwerp. This fleet will shortly inaugurate Europe's first regular international services by helicopter.

CIVIL AVIATION . . .

Marsh area, will be known as Ferryfield. Initially, it will have two runways: one of 5,000ft and the other of 4,200ft. The runway and taxi-track configuration will be so arranged that aircraft spend the absolute minimum of time on the ground. Large terminal buildings, designed from the start to cater for both passengers and vehicles, will be constructed by Silver City. Negotiations for the purchase of land are now in progress and it is hoped that the first runway will be ready for use next summer.

"A further factor which has influenced Silver City in their decision to construct Ferryfield is the complete lack on the south-eastern coast of England of an air ferry terminal which could accommodate the large four-engined, double-decker, eight-car carriers with which Silver City plan to supplement their existing fleet of 14 Bristol Freighters and Superfreighters. . . . The present plan is to use Blackburn Universals as soon as they are available, but a useful substitute is immediately available in the Breguet Deux-Ponts, one of which is now on trial by the company [to carry freight between Hamburg and Berlin]."

The cost of the new terminal will, it is expected, be in the region of £140,000, of which £80,000 will be spent during the next 12 months.

A NEW SOUND BARRIER

TESTS on the recently completed acoustic screening wall at London Airport began on the evening of Thursday, July 9th. The wall, built at a cost of £16,000, near the B.O.A.C. hangar now under construction, is intended both to reduce the immediate noise nuisance to the people living in and near Cranford, and to check the agreement of practice with theory concerning the effect of such noise-reducing devices. In charge was Dr. G. E. Bell, M.Sc., Ph.D., the M.C.A.'s head of operational research.

The wall has been constructed following tests on a temporary asbestos screen on a steel framework. It is 30ft high (an additional 10ft extension is planned), and of "flattened V" plan form.

The aircraft used in the initial tests was a York, the engines of which were run at full throttle for periods of some three minutes at various positions away from, and in the shelter of, the wall. Noise-levels were measured and recorded by M.C.A. scientists at three listening stations, two situated in school buildings in Cranford, and the other being a mobile station investigating the effects at the edge of the sound "shadow" on the flanks of the wall. The measuring and recording stations were all located between 1,500ft and 2,000ft from the aircraft.

After maintenance in the adjacent hangar, running-up of engines will normally take place with the aircraft facing the wall, although the tests included the tail-in position. Using the nose-in position, the whole of the new B.O.A.C. hangar—situated to the side of the wall—is screened from the source of noise. A specially built access-track connects the wall area with the hangar approaches.

To an observer near the scene of the tests, the noise reduction due to the wall seemed considerable, amounting possibly to some 20 to 25 decibels. A series of further tests are being carried out, and the noise-level readings obtained will be examined and checked against the forecast values by the M.C.A.

MODELLERS DEFY THE WEATHER

EVERY summer since 1931—with the exception, of course, of the war period—the Northern Heights Model Flying Club has held its annual gala day, and usually it has been fortunate in the weather. Last Sunday it was less lucky; the day began dismally, with torrents of rain and a blustering wind. But it takes more than that to damp the spirits of your true aeromodeller, and by 10 a.m. the usual thousands were converging on Langley Airfield, near Slough (generously placed at the club's disposal once more by Hawker Aircraft, Ltd.) by almost every mode of conveyance and from as far afield as Lancashire. They were rewarded, if not by a clearance, at least by a cessation of the downpour, though the gusty wind continued.

The organization, by a team of highly capable officials under the presidency of the club's equally keen president, Dr. A. P. Thurston, was of a kind that might well set a standard for many full-scale flying events. Half-a-dozen contests were proceeding simultaneously in various parts of the airfield all day, each with scores of entrants whose flights had to be timed and logged.

There were, perhaps, fewer technical novelties than in past years, though some deltas were to be seen, and at least one ducted-fan model—that which we noticed was a Swift, in the fuselage-centre of which was a petrol engine driving a multi-bladed sheet-metal fan of 5in diameter.

The principal contest was the annual one for the Queen Elizabeth Cup, which is now presented for large power-driven models weighing at least 30 oz. This year's winner was L. Barr, who is production manager at Westway Models of Acton. His 6ft-span high-wing monoplane, powered with a 5 c.c. engine running at 12,000 r.p.m. was designed and built within a week of the meeting, crashed in its first test-flight on the Friday and was rebuilt on the Saturday!

The *Flight* Cup—given, as usual in a duration contest for gliders—was won by A. Brooks with an aggregate of 452.6 sec for two flights, an excellent performance under anything but ideal gliding conditions.

The principal prizes were presented by Lady Camm and both she and Sir Sydney (it will be recalled that Hawker's chief designer was knighted in the Coronation Honours) were prevailed upon to "say a few words"; the latter, after recalling that he himself had started model-making in 1912, remarked that the pastime formed a fine introduction to aircraft engineering.

As is their custom on this occasion, the directors of the company entertained a number of friends to lunch. Among the guests who accepted invitations were Air Chief Marshal Sir Hugh P. Lloyd, lately C-in-C. Bomber Command, and president of the R.A.F. Model Aircraft Association; A.V-M. L. J. V. Bates, Director-General of Equipment, Air Ministry; A. Cdre. J. G. Weston, commandant at Halton; Air Marshal Sir John D'Albiac, commandant of London Airport; Lord and Lady Sempill; Mr. E. Bowyer, director of the S.B.A.C.; Dr. A. M. Ballantyne, secretary of the R.Ae.S.; and several senior officers from the Australian, Canadian and American Government departments in this country, including Gen. D. Callahan, U.S.A.F.

Those successful in the various contests, with—where applicable—their clubs and points gained, were :—

The Queen Elizabeth Cup.—1, L. Barr, 495.5; 2, R. Mead, 410; 3, R. Law, 408.

Thurston Helicopter Trophy.—1, C. M. Ingram (Wilmot Mansour Club), 180; 2, A. Hodgson (Andover), 177; 3, D. Smith, 158.

De Havilland Trophy (power-driven models).—1, C. Marsh (Ilford), 491; 2, B. Cullen (Sittingbourne), 302; 3, R. Cullinane, 301.

Coronation Cup (control-line team race, Class A).—South Bristol M.F.C.

"Model Engineer" Cup (control-line team race, Class B).—West Essex M.F.C.

"Flight" Trophy (gliders).—A. Brooks (Grange), 452.6; 2. J. O'Donnell (Whitefield), 377; 3, R. Law (W. Middlesex), 342.

Fairey Cup (rubber-powered models).—1, P. Allaker (Surbiton), 520; 2, P. Giggle (Brighton), 509.8; 3, J. O'Donnell (Whitefield), 494.

"R.A.F. Flying Review" Cup (radio control).—1, S. Sutherland, 87; 2, G. W. Merrick, 85; S. A. Miller, 64.

"Aeromodeller" Challenge Cup (best aggregate performance).—J. O'Donnell (Whitefield).

Concours d'Elegance.—Power, R. Hill; general flying models, A. Smallwood; flying scale models, H. T. Jackson (Sopwith Snipe model); unorthodox models, J. Marshal (Autogiro).

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

FLY-PAST GLIMPSE: An impression, taken from a Transport Command Hastings during a rehearsal, of how much aircrews participating in the fly-past would see of the Royal Review parade at Odiham.
"Flight" photograph

R.N.F.C. "At Home"

BAD weather restricted the attendance and activities at the annual "At Home" of the Royal Naval Flying Club at Gosport last Sunday. Indeed, part of our road journey from London had been made through cloud, hanging low on the hills, and it was no surprise that the only airborne visitors to arrive had come from nearby Portsmouth.

After an excellent lunch in the wardroom of H.M.S. *Siskin*, awards were made at the club-house to winners of the various competitions. To Mr. H. Mitchell, C.F.I. of the Portsmouth Club—in Autocrat G-AIGU—went two prizes, one for possessing the most elegance in the *Concours*, and one for arriving at the predetermined and sealed time. Mr. P. Wannop of the same club repeated his Fair Oaks success with Messenger G-AVWB to win a further bottle of the gin on which his aircraft is alleged to run. By parking nearest to the club-house, he was adjudged to have travelled the greatest distance. The prizes were presented by Mrs. McWilliam, wife of Captain H. H. McWilliam, R.N. (Rtd), one of the directors of the club.

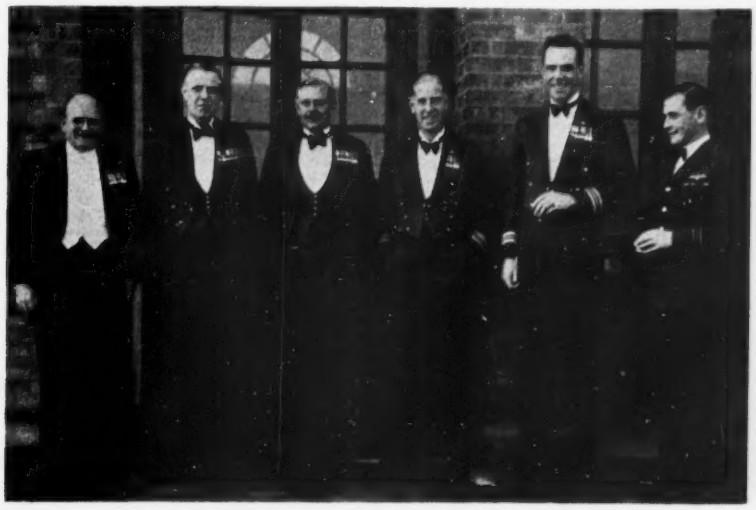
101 Celebrates

ON Thursday evening of last week, No. 101 Squadron celebrated 36 years of existence by holding a guest night, at which a number of wartime and pre-war members were present. Among these were A.V-M. J. R. Whitley, A.O.C. No. 1 Group (a flight commander in 1931), A.V-M. W. J. Seward, A.O.C. No. 63 Group, and A.V-M. F. C. B. Betts, who commanded the unit in 1933. Present also was Mr. J. D. North, chairman and managing director of Bolton Paul Aircraft Ltd. It was Mr. North who designed the Boulton and Paul Sidestrands and Overstrands with which No. 101 was equipped in 1934, and it was because of the latter being the first machine in service to have a power-operated turret that a turret—albeit a castellated one—appears in the squadron badge. This turret was one of the special items demonstrated to the late King George V at the Royal Review held at Mildenhall in 1935.

After-dinner speakers all recalled old days with No. 101, J. D. North remembering that S/L. Coleman, when he was not flying Sidestrands, practised the pastimes of glass-eating and fireblowing; the latter is not an entirely lost art in the squadron today.

G/C. N. C. Hyde, the Station Commander at Binbrook, proposed the toast of the squadron and referred to the halo which surrounds No. 101 as the first unit to get Canberras. That the pilots are the glamour boys of Bomber Command is believed, he said—even by the Wing Commander Flying.

For S/L. John Crampton the occasion was his last guest night with the squadron as its commanding officer, before handing over to S/L. W. D. Robertson next week. He is off to a staff appointment at No. 1 Group—his first non-flying job for over 13 years. With no Canberras to fly he will have to content himself with some fast motoring in his Maserati.



"Flight" photograph

IN CHRONOLOGICAL ORDER: Six commanding officers attending No. 101 Squadron's thirty-sixth anniversary: A.V-M. F. C. B. Betts (1933), S/L. R. I. Alexander (1944), W/C. M. H. de L. Everest (1944), S/L. P. Wimberley (1948), S/L. J. Crampton (1952) and S/L. W. D. Robertson, who takes over next week. (See "101 celebrates," above.)

"Binder"

PET of the late W/C. Paddy Finucane—and indeed of the many hundreds who have passed through Hornchurch since the Battle of Britain—"Binder," the station mascot, is dead. Found in a half-drowned condition he had to be destroyed.

He was a puppy in the early 1940s and grew up in an atmosphere of war, waiting always for his master to return from operations. When the unhappy day came that Paddy did not return, "Binder" roamed the camp for many days looking for his master. From then onward he was a station dog, with many friends, but no master.

More Arctic Supply Flights

FOR the third year in succession, the R.A.F. is to undertake a series of flights within the Arctic Circle to assist the British North Greenland Expedition.

On August 1st, five Sunderlands of No. 201 Squadron commanded by S/L. R. A. N. McCready, will leave R.A.F. Station Pembroke Dock, South Wales, for Greenland. Their base will be at Young Sound, on the north-east coast (position 74 deg 29′ N, 20 deg 40′ W), to which the expedition ship, the *Polarsirkel*, will deliver the stores. On August 5th the

HOME GROWN: Mr. Eric Harrison, Australian Minister for Defence Production, and John Miles, chief test pilot of the Government aircraft factory at Melbourne, with the first Australian-built Canberra, which made its first flight from the Avalon airfield in June. (Right) A line of Australian-built D.H. Vampire 53s (Rolls-Royce Nene) at No. 2 Fighter Operational Training Unit at Williamstown, New South Wales.

SERVICE AVIATION . . .

Sunderlands will start to fly 70 tons of stores to the expedition's main camp at Britannia Lake (77 deg 07′ N, 23 deg 40′ W), some 190 miles from Young Sound. The task should be completed in from 7 to 10 days.

In mid-August, two Hastings, commanded by S/L. E. Robinson, O.B.E., will leave R.A.F. Station Abingdon, Berks, for the United State Air Force base at Thule, in north-western Greenland. Their task is to drop some 60 tons of supplies, chiefly petrol for the "weasel" tracked vehicles, to the existing advanced camp at position 78 deg 02′ N, 37 deg 50′ W, now known as "Northice," and also to establish a petrol dump in a position 200 miles to the west of Northice. The supply drops are due to start on August 20th, and should be completed in about ten days.

Naval Appointments

THE following appointments in the rank of captain have been announced by the Admiralty:— Capt. A. C. G. Ermen to the Admiralty as Director of Air Equipment and Naval Photography; Capt. R. W. F. Northcott to R. N. Air Station St. Merryn, in command; Capt.(E) C. B. Pratt as Chief of Staff to Rear-Admiral Reserve Aircraft; Capt.(E) A. J. Tyndale-Biscoe to R.N. Air Station Anthorn, in command; Capt.(E) N. J. Clift, Superintendent R.N. Aircraft Yard Donibristle, in continuation; and R.N. Air Station Donibristle, in command.

R.N.V.R. Air Division Move

THE transfer of the Southern Air Division of the R.N.V.R. from Culham, Berkshire, to R.A.F. Station Benson, Oxfordshire, is expected to be completed by the end of this month. The senior squadron, No. 1832, has had its home at Culham since 1947.

Half-yearly Promotions

THE following list of half-yearly promotions is continued from page 70:—

GENERAL DUTIES BRANCH. *Squadron Leader to Wing Commander.*—F. J. Fenton, P. C. Lambert, I. L. B. Aitkens, C. V. Beadon, D.F.C., W. Beringer, F. V. Morello, W. J. McLean, D.S.O., D.F.C., A.F.C., G. H. Porter, T. H. B. Tayler, R. J. Sage, A.F.C., L. H. Trent, V.C., D.F.C., P. A. Ostle, H. W. Lamond, J. E. Watts, A.F.C., G. W. Cory, A.F.C., V. C. Woodward, D.F.C., J. W. Louw, O.B.E., D.F.C., J. C. Graham, D.F.C., G. H. Nelson-Edwards, D.F.C., J. B. A. Fleming, O.B.E., A. H. Simmonds, D.F.C., C. C. F. Cooper, T. N. Silk, J. W. Appleton, C. Marshall, M.B.E., I. M. Gundry-White, D.F.C., R. D. Max, D.S.O., D.F.C., P. G. H. Matthews, D.F.C., F. O. Barrett, D.F.C., F. J. French, D.F.C., A.F.C., B. E. Peck, D.F.C., D. F. Hyland-Smith, D.F.C., D. R. Bagnall, D.S.O., D.F.C., A. W. Horne, D.F.C., A.F.C., G. J. C. Hogan, D.F.C., J. N. Stacey, D.S.O., D.F.C., T. R. Pierce, J. R. H. Merifield, D.S.O., D.F.C., F. D. S. Scott-Malden, D.S.O., D.F.C., G. M. Brisbane, D.S.O., D.F.C., D.F.M., W. J. O. Coleman, D.F.C., F. W. Higginson, D.F.C., D.F.M., J. R. Denny, M.B.E., D.F.C., A. Reece, D.S.O., D.F.C., A.F.C., D. T. M. Lumsden, M.B.E., R. B. Morison, D.F.C. and R. W. Pye.

Flight Lieutenant to Squadron Leader.—M. T. Wainwright, A.F.C., D. S. Dickins, J. R. Pitchie, A.F.C., P. F. Morfill, D.F.M., J. J. O'Meara, D.S.O., D.F.C., S. Wandeilak, D.F.C., F. C. Wilson, C. M. Stavert, A.F.C., R. M. Chatfield, D.F.C., D. B. Delany, A.F.C., F. G. Constable, D.F.M., A. S. Aldridge, D.F.C., J. R. Saunders, R. Edwards, D.S.O., N. L. R. Cowan, D.F.C., G. D. Cremer, A.F.C., E. T. Ware, D.F.C., K. H. Houghton, D.F.C., A. E. Harkness, A.F.C., L. H. Wakeford, D.F.C., I. L. Dunn, R. H. C. Powling, F. C. Ellis, I. D. Crozier, F. G. DePass, G. W. Turner, D.F.M., P. F. T. Wakeford, O.B.E., W. A. Young, B. R. Hall, D F.C., A.F.C., C. E. Cruwys, G. G. A. Davies, D.F.C., K. A. Perkin, A. N. Bristow, D.F.C., A.F.C., S. G. Nunn, D.F.C., L. V. Craxton, J. D. Hawkins, A.F.C., C. D. A. Browne, D.F.C., P. H. Waterkeyn, D.F.C., V. A. Hester, D.F.C., G. A. Bere, W. J. T. Henderson, D. E. Breed, D. F. Liddle, W. J. Potocki, D.F.C., E. M. Sparrow, D.F.C., H. L. Hartley, R. G. Ravenscroft, R. Currie, A.F.C., L. G. A. Reed, M.V.O., D.F.C., S. H. Redmond, E. D. Herbert, A.F.C., L. W. Birchall, G. E. R. Parr, K. B. Rogers, D.F.C., A.F.C., W. J. P. Straker, J. B. McWilliams, D. B. Webb, D.F.C., B. L. Partridge, A. H. Chamberlain, H. D. Costain, D. A. Dobbie, A.F.C., E. F. Brown, D.F.C., S. G. Hewitt, A.F.C., R. A. Schofield, D. R. Higgin, J. Dalgleish, J. A. L. Currie, D.F.C., W. D. Robertson, C. McI. Cassels, J. G. Claridge, D.F.C., A.F.C., P. Barber, D.F.C., E. H. Taylor, A.F.C., D. M. Surtees, L. H. G. Coles, D.F.C., E. M. Hunter, D.F.C., D.F.M., J. Miller, D.F.C., A.F.C., M. Scannell, D.F.C., A.F.C., D. R. D. Ellerton, R. A. Carson, M.C., E. A. Brittain, A.F.C., M. C. S. Shepherd, O.B.E., C. W. Cornish, R. E. Lelong, D.F.C., R. J. H. Uprichard and C. W. Watson, A.F.C.

ASYMMETRIC APPROACH: A Viking of the Queen's Flight, with one airscrew feathered, comes in over the hedge at Benson, Oxfordshire.

R.F.C.—R.N.A.S. Dinner Club

There is a proposal that an R.F.C.-R.N.A.S. officers' dinner club is formed with its headquarters at the R.A.F. Reserves Club, 14, South Street, London, W.1. The object is for members to hold an annual dinner; the first of which is expected to take place during next October or November. Readers interested in this project should write to the Hon. Sec. R.F.C.-R.N.A.S. Dinner at the above address.

Reunion

IT is proposed to hold the first post-war reunion of past and present officers of No. 70 Squadron on Friday, October 30th. Particulars from S/L. C. D. Griffiths, R.A.F. Club, 128 Piccadilly, London, W.1, or W/C. Reavell-Carter, M.B.E., P8, Air Ministry, Adastral House, London.

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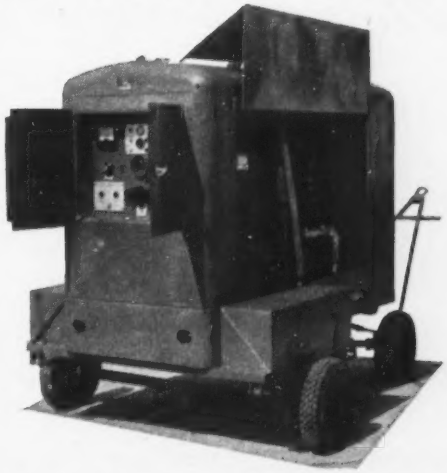

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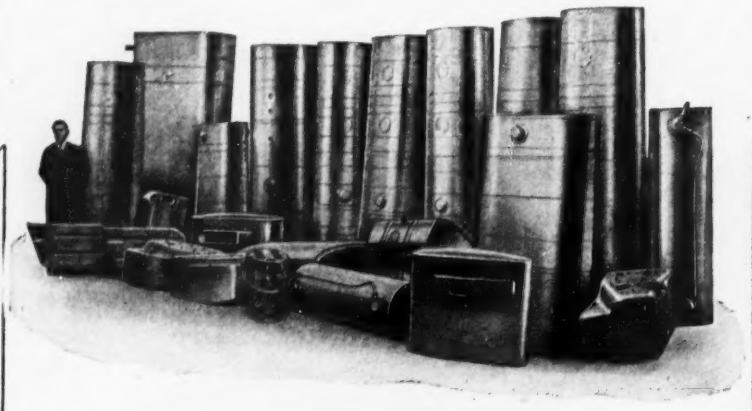

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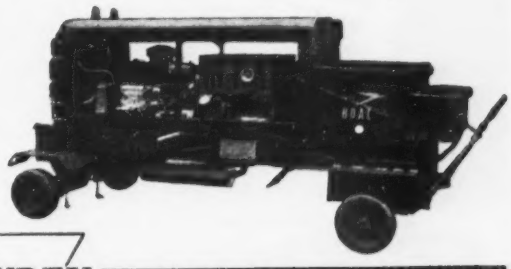

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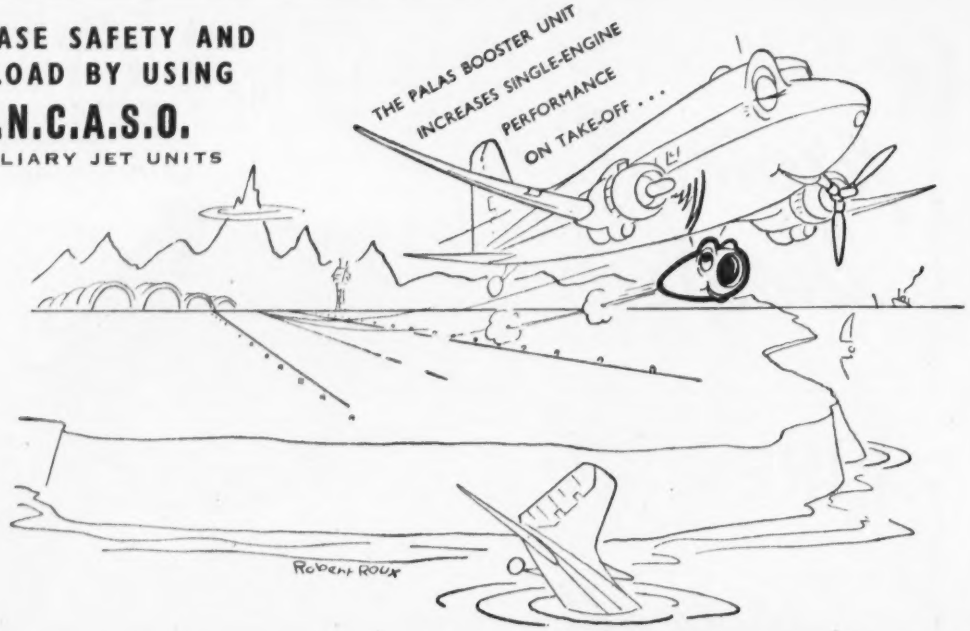

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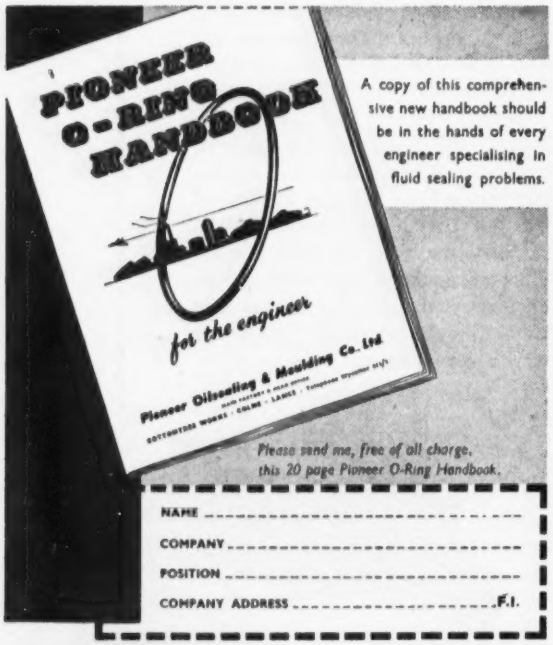

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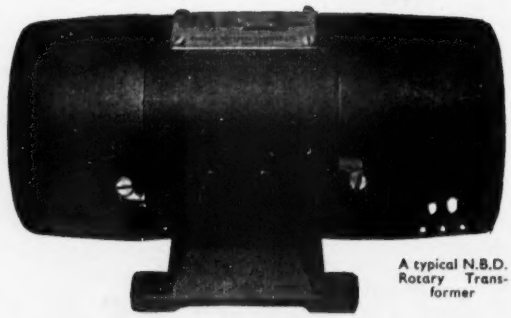

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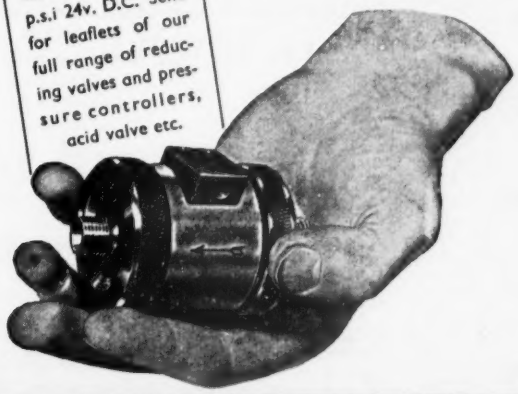

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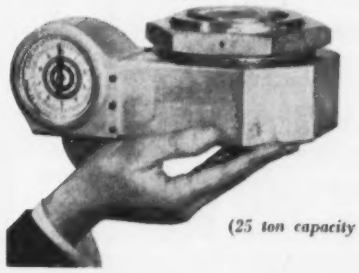

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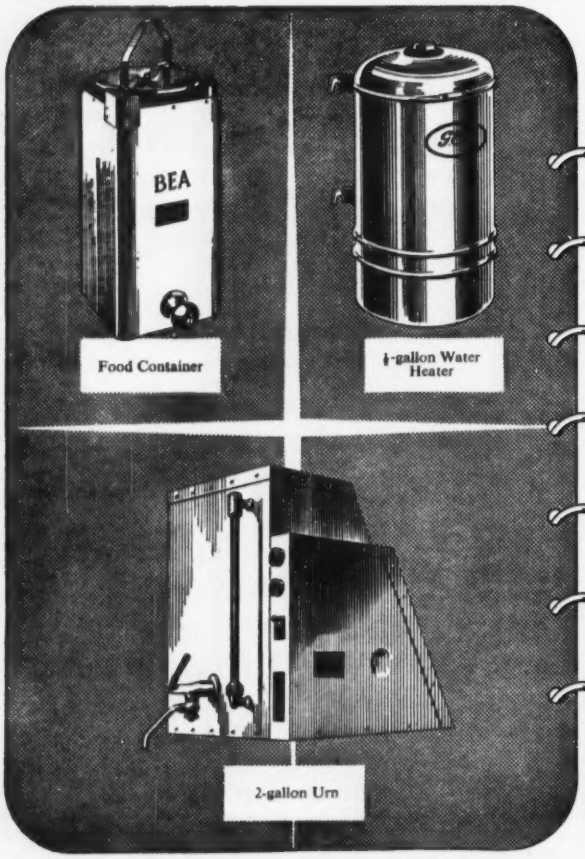

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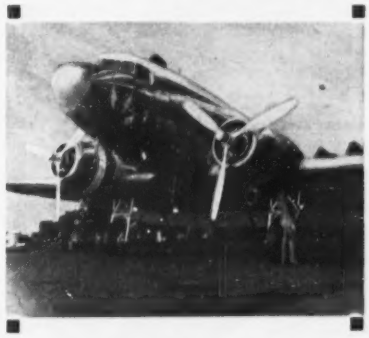

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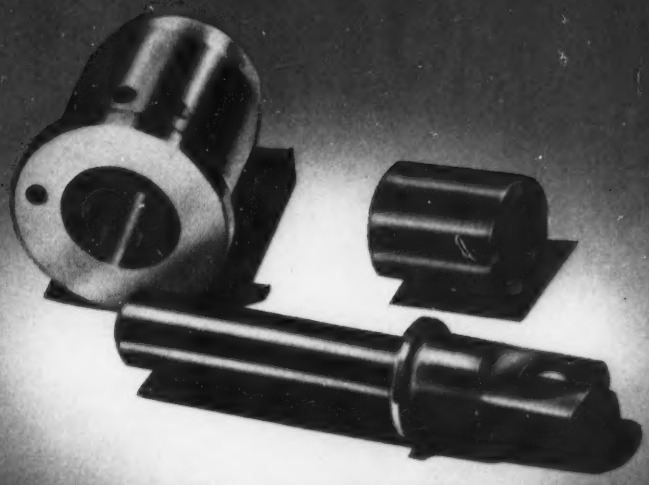

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